

1990

Transgressions and Regressions in the Barataria Bight Region of Coastal Louisiana. (Volumes I and II).

Douglas Ross Levin

Louisiana State University and Agricultural & Mechanical College

Follow this and additional works at: https://digitalcommons.lsu.edu/gradschool_disstheses

Recommended Citation

Levin, Douglas Ross, "Transgressions and Regressions in the Barataria Bight Region of Coastal Louisiana. (Volumes I and II)." (1990). *LSU Historical Dissertations and Theses*. 5072.
https://digitalcommons.lsu.edu/gradschool_disstheses/5072

This Dissertation is brought to you for free and open access by the Graduate School at LSU Digital Commons. It has been accepted for inclusion in LSU Historical Dissertations and Theses by an authorized administrator of LSU Digital Commons. For more information, please contact gradetd@lsu.edu.

INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.



University Microfilms International
A Bell & Howell Information Company
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
313/761-4700 800/521-0600

Order Number 9123215

**Transgressions and regressions in the Barataria bight region of
coastal Louisiana. (Volumes I and II)**

Levin, Douglas Ross, Ph.D.

The Louisiana State University and Agricultural and Mechanical Col., 1990

U·M·I

**300 N. Zeeb Rd.
Ann Arbor, MI 48106**

NOTE TO USERS

**THE ORIGINAL DOCUMENT RECEIVED BY U.M.I. CONTAINED PAGES
WITH SLANTED AND POOR PRINT. PAGES WERE FILMED AS RECEIVED.**

THIS REPRODUCTION IS THE BEST AVAILABLE COPY.

TRANSGRESSIONS AND REGRESSIONS
IN THE
BARATARIA BIGHT REGION
OF COASTAL LOUISIANA

Volume I

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University
Agriculture and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Marine Sciences

by
Douglas Ross Levin
B.S., Fairleigh Dickinson University
M.A., Boston University
December 1990

DEDICATION

This work is dedicated to John Mestayer and his puppy, "Chaco". Neither Paul or I can reprimand you for your attempt to save a friend in distress. We cannot honestly say that we would'nt have done the same for our own.

ACKNOWLEDGEMENTS

The task of writing the acknowledgements is as difficult as writing any chapter in this dissertation. So many people have crossed through my life in the seven years since beginning this work. Some of those will go unnamed here, but not forgotten.

To begin with I would like to thank my family for their patience and gentle encouragement as I worked diligently to finish my schoolwork. In memorial, I would like to apologize to my Grandpa Harry and Grandmas Claire and Sylvia that they could not say "meet my Grandson, the doctor". Perhaps they will do so in spirit.

This work was funded in part by Sohio, Arco, GCAGS, Rockefeller Scholarships, and the Department of Marine Sciences. Sohio was most generous, providing me with a computer, and all but one of my Carbon-14 dates. Fonda Kearns of the now defunct Louisiana Geological Survey Carbon-14 lab allowed me to trade my typewriter for my last analysis. The core acquisition was paid for by the Louisiana Geological Survey. The bulk of my dissertation funding was provided by "Mr. Pocket". "Mr. Pocket" is grateful for the patience afforded to him by Ocean Surveys Inc. of Old Saybrook, Connecticut, Atlantic Environmental Services of Colchester, Connecticut and CERC, Vicksburg, Mississippi during my tenure with those groups. American Express is also acknowledged for providing a "bridge loan" (of sorts) that allowed me to work

on my dissertation for three months before they yanked my card and forced me to go to work full time. Pete Lackey, soon to be famous novelist, is thanked for spending some long hours trying to make this dissertation more presentable with his cartographic skills. Dupe and Mary Lee Eggert of the Louisiana State University Cartographic Laboratory are responsible for drafting the bulk of the figures. Photographs were printed by Kerry Lyle. Peter Jackson helped compile the final manuscript.

The field work was completed with the assistance of the Sea Grant boat facilities run by Captain Bob Seal. I am indebted to him and his crew for their patience, sense of humor and graciousness in allowing me not only to return boats in various states of disrepair but giving me new ones to take out without so much as a whimper. Command central for vibracoring operations was located on Grand Terre, in the Wildlife and Fisheries camp. Thanks to that facility our nights were comfortably cool compared to unbearable days in the field.

Vibracoring was accomplished with the help of my "two-legged forklifts" Paul Templet and Michael Halun. Part of the vibracore crew also included Scott Jeffries, John Mestayer and Adam Shamban. My faithful field dog, the late "Willie", accompanied all field excursions. Willie is also acknowledged for his constant companionship during the doctoral program. The contribution that Willie made to my "life experience"

education furthered my desire to finish my degree. Scott Jeffries and Paul Templet also assisted in the core processing portion of this dissertation.

My friends in the Marine Science department should also be acknowledged. Scott Dinnel is acknowledged and blamed for his contributions and frequent office visits to discuss the days news, sports, and anything else we could think of to avoid working. Charlie Alexander is thanked for friendship and encouragement as an officemate. Words within this acknowledgement cannot alone express the importance Gary Shaffer's friendship has played in bringing this portion of my life to a close. I would also like to acknowledge Petor Cahoon of the University of British Columbia for his initial help with computer generated geologic core logs. "SMARTCORE" was not incorporated into this dissertation, however, it is represented by small drops of blood, sweat, and tears that stain some of the hand drawn figures.

My present committee members Dag Nummedal, Jim Coleman, Jim Gosselink, Harry Roberts, Bill Wiseman are thanked wholeheartedly for reviewing my work and adding to its overall quality. Jim Coleman provided me with a valuable opportunity to work an extended cruise in the Gulf of Mexico with Gulf Oil. The money earned from that work bankrolled a large portion of the core preparation and description phases of this dissertation. Dag Nummedal is acknowledged as a friend and as an advisor. He brought me to LSU, helped me find work when I

needed the money (continually) and never forgot me during my absence from LSU occasionally surprising me with a phone call to remind me of him. Thanks to Dag for taking time out of his extraordinary schedule to see me through to the end. Dag is responsible for providing the push to make this dissertation something I can be proud of.

Finally, to my new wife, Debbie. It was fitting that I share with you the monumental task of finishing this portion of my life. From here on the world is my oyster and you are the pearl.

TABLE OF CONTENTS

Volume I

DEDICATION.....	ii
ACKNOWLEDGEMENTS.....	iii
LIST OF TABLES.....	xv
LIST OF FIGURES.....	xvi
ABSTRACT.....	xxxii
1. INTRODUCTION.....	1
THE DELTA CYCLE.....	1
STUDY AREA LOCATION	7
COASTAL PROCESSES.....	9
Tides	9
Wave Climate.....	11
Wave Approach	11
PAST RESEARCH IN THE BARATARIA SHORELINE AREA.....	13
OBJECTIVES.....	15
2. METHODS AND MATERIALS.....	17
HISTORICAL ANALYSIS.....	17
FIELD WORK.....	18
Offshore Data Set	18
Coastal/Onshore Dataset	22
Core Acquisition	22
Core Positioning.....	25
LABORATORY METHODS.....	25
Core Preparation	25
Core Description	27
Coarse Sediment Analysis	28
X-Ray Radiography.....	28
Radiocarbon Dating	29
Graphic Presentation of Core Information.....	30
3. FACIES DESCRIPTION, CHARACTERIZATION AND INTERPRETATION	32
PART I - SUBSURFACE FACIES INTERPRETATION.....	33
Lithofacies BF	33
Description.....	33
Processes.....	37
Interpretation.....	39
Lithofacies DF.....	41
Description.....	41

Processes.....	45
Interpretation.....	48
Lithofacies CH.....	49
Description.....	49
Processes.....	55
Interpretation.....	57
Lithofacies OB.....	59
Description.....	59
Lithofacies OB-C.....	60
Lithofacies OB-F.....	60
Lithofacies OB-Summary.....	65
Processes.....	65
Interpretation.....	67
Lithofacies BY.....	71
Description.....	71
Processes.....	76
Interpretation.....	80
Lithofacies BKBR.....	83
Description.....	83
Processes.....	87
Interpretation.....	91

PART II - SUBSURFACE CHARACTERIZATION OF EXPOSED ENVIRONMENTS

.....	93
Marsh.....	93
Tidal Pass Lithofacies.....	102
Recurved Spits.....	104
Geomorphology.....	104
Lithofacies Description.....	109
Pass Platform.....	114
Geomorphology.....	114
Lithofacies Description.....	114
Flood Tidal Delta.....	118
Geomorphology.....	118
Lithofacies Description.....	118
Channel Margin.....	120
Geomorphology.....	120
Lithofacies Description.....	120
Barrier Lithofacies.....	123
Geomorphology.....	123
Lithofacies Description.....	127
4. OFFSHORE STRATIGRAPHY OF THE BARATARIA REGION.....	130
Introduction	130
Transect Offshore A-A'.....	130
Transect A-A' / Parasequence F-Re.....	130
Description.....	130
Interpretation.....	132
Transect A-A' / Parasequence F-Tr.....	132
Description	132
Interpretation	134
Transect A-A' / Parasequence BB-Re.....	136

Description	136
Interpretation	136
Transect Offshore B-B'	136
Transect B-B' / Parasequence F-Re	136
Description	136
Interpretation	138
Transect B-B' / Parasequence F-Tr	138
Description	138
Interpretation	139
Transect B-B' / Parasequence BB-Re	139
Description	139
Interpretation	139
Transect B-B' / Parasequence BB-Tr	142
Description	142
Interpretation	142
Transect B-B' / Parasequence Ms-Re	142
Description	142
Interpretation	143
Transect Offshore Dip C-C'	143
Transect C-C' / Parasequence F-Re	145
Description	145
Interpretation	146
Transect C-C' / Parasequence F-Tr	146
Description	146
Interpretation	147
Transect C-C' / Parasequence BB-Re	147
Description	147
Interpretation	147
Transect C-C' / Parasequence BB-Tr	150
Description	150
Interpretation	150
Transect C-C' / Parasequence Ms-Tr	150
Description	150
Interpretation	150
5. PASS ABEL STRATIGRAPHY	151
Data Description	151
Transect PAN - Description and Interpretation	151
Transect PAN / Parasequence F-Tr	151
Description	151
Interpretation	151
Transect PAN / Parasequence BB-Re	154
Description	154
Interpretation	154
Transect PAN / Parasequence BB-Tr	155
Description	155
Interpretation	155
Transect PAN / Parasequence Ms-Re	155
Description	155
Interpretation	155

Transect PAN / Parasequence Md-Tr.....	157
Description.....	157
Interpretation	157
Transect PAE - Description and Interpretation.....	158
Transect PAE / Parasequence F-Tr.....	158
Description	158
Interpretation.....	158
Transect PAE / Parasequence BB-Re.....	158
Description	158
Interpretation	159
Transect PAE / Parasequence BB-Tr.....	159
Description.....	159
Interpretation.....	159
Transect PAE / Parasequence Ms-Re.....	162
Description	162
Interpretation.....	162
Transect PAE / Parasequence Md-Tr.....	163
Description	163
Interpretation	163
Transects PAW and PAS - Description and Interpretation	
.....	163
Transects PAW/PAS / Parasequence BB-Re.....	163
Description	163
Interpretation	166
Transect PAW/PAS / Parasequence BB-Tr.....	166
Description	166
Interpretation	166
Transect PAW/PAS / Parasequence Ms-Re.....	168
Description.....	168
Interpretation.....	169
Transect PAW/PAS / Parasequence Md-Tr.....	169
Description	169
Interpretation.....	170

6. QUATRE BAYOU PASS STRATIGRAPHY.....171

Data Description.....	171
Transect QBP-B Description and Interpretation.....	171
Transect QBP-B / Parasequence BB-Re.....	171
Description	171
Interpretation	174
Transect QBP-B / Parasequence BB-Tr.....	174
Description	174
Interpretation.....	175
Transect QBP-B / Parasequence Ms-Re.....	175
Description	175
Interpretation	176
Transect QBP-B / Parasequence Md-Tr.....	176
Description	176
Interpretation.....	176
Transect QBP-S Description and Interpretation.....	177
Transect QBP-S / Parasequence BB-Re.....	177

Description	177
Interpretation	177
Transect QBP-S / Parasequence BB-Tr.....	179
Description	179
Interpretation.....	179
Transect QBP-S / Parasequence Ms-Re.....	179
Description	179
Interpretation.....	180
Transect QBP-S / Parasequence Md-Tr.....	180
Description	180
Interpretation	180
Transect QBP-C Description and Interpretation.....	181
Transect QBP-C / Parasequence BB-Re.....	181
Description	181
Interpretation	181
Transect QBP-C / Parasequence BB-Tr.....	181
Description	181
Interpretation.....	181
Transect QBP-C / Parasequence Ms-Re.....	181
Description	181
Interpretation.....	183
Transect QBP-C / Parasequence Md-Tr.....	183
Description.....	183
Interpretation	183
Transect QBP-D Description and Interpretation.....	184
Transect QBP-D / Parasequence BB-Tr.....	184
Description	184
Interpretation.....	184
Transect QBP-D / Parasequence Ms-Re.....	184
Description.....	184
Interpretation.....	184
Transect QBP-D / Parasequence Md-Tr.....	186
Description	186
Interpretation.....	186
7. PASS RONQUILLE STRATIGRAPHY	187
Data Description.....	187
Transect CR-C Description and Interpretation.....	187
Transect CR-C / Parasequence BB-Tr.....	187
Description.....	187
Interpretation.....	190
Transect CR-C / Parasequence Ms-Re.....	190
Description	190
Interpretation.....	191
Transect CR-C / Parasequence Ms-Tr.....	191
Description.....	191
Interpretation	192
Transect CR-C / Parasequence Md-Tr.....	193
Description.....	193
Interpretation	193
Transect CR-B Description and Interpretation.....	193

Transect CR-B / Parasequence BB-Tr.....	193
Description	193
Interpretation.....	193
Transect CR-B / Parasequence Ms-Re.....	193
Description.....	193
Interpretation.....	195
Transect CR-B / Parasequence (L) Ms-Re.....	195
Description.....	195
Interpretation.....	196
Transect CR-B / Parasequence Md-Tr.....	196
Description.....	196
Interpretation	196
Transect CR-D Description and Interpretation.....	196
Transect CR-D / Parasequence BB-Tr.....	196
Description	196
Interpretation	197
Transect CR-D / Parasequence Ms-Re.....	197
Description	197
Interpretation.....	199
Transect CR-D / Parasequence Ms-Tr.....	199
Description.....	199
Interpretation.....	199
Transect CR-D / Parasequence (L) Ms-Re.....	199
Description.....	199
Interpretation	200
Transect CR-D / Parasequence Md-Tr.....	200
Description	200
Interpretation	200
Transect CR Description and Interpretation.....	200
Transect CR / Parasequence BB-Tr.....	201
Description	201
Interpretation.....	201
Transect CR / Parasequence BB-Tr.....	201
Description	201
Interpretation.....	203
Transect CR / Parasequence Ms-Re.....	203
Description	203
Interpretation	204
Transect CR / Parasequence (L) Ms-Re.....	205
Description.....	205
Interpretation.....	205
Transect CR / Parasequence Md-Tr.....	207
Description.....	207
Interpretation.....	207

Volume II

8. LATE HOLOCENE HISTORY OF THE BARATARIA COASTAL REGION	208
.....	208
SEQUENCE OF TRANSGRESSIONS AND REGRESSIONS.....	208
Bayou des Familles Regression.....	208

Bayou des Families Transgression.....	211
Bayou Blue Regression.....	213
Bayou Blue Transgression.....	219
Mississippi Lobe Regression.....	223
Modern Barataria Shoreline Transgression.....	231
CHRONOLOGY OF TRANSGRESSIONS AND REGRESSIONS.....	231
Bayou Blue Transgression	233
Mississippi Lobe Regression.....	235
Late Lafourche Progradation.....	235
Mississippi Lobe Transgression	236
Bayou des Families Transgression	236
Bayou des Families Regression	237
Recent Delta Progradations Along the Barataria Shoreline.....	237
SUMMARY OF BARATARIA GEOLOGIC HISTORY.....	244
CONCLUSIONS REGARDING BARATARIA GEOLOGIC HISTORY.....	246
9. HOLOCENE SEA LEVEL CHANGE IN THE MISSISSIPPI DELTA REGION.....	248
INTRODUCTION.....	248
Relative Sea Level Rise.....	248
Eustatic Sea Level Changes in the Gulf of Mexico.....	254
Objectives.....	256
DATA/RESULTS.....	259
Families Regression.....	259
Families Transgression.....	259
Sea Level Changes During the Bayou Des Families Delta Cycle.....	260
Bayou Blue Regression.....	261
Bayou Blue Transgression.....	262
Mississippi Regression.....	263
Mississippi Transgression.....	264
DISCUSSION.....	265
CONCLUSIONS.....	266
10. INLET EVOLUTION IN THE MISSISSIPPI RIVER DELTA PLAIN.....	267
INTRODUCTION.....	267
Objectives.....	268
STUDY AREA.....	269
Geologic Setting.....	269
Barrier Formation in the Mississippi Delta Plain.....	269
Relative Sea Level Change in the Delta Plain.....	270
TIDAL INLET MORPHOLOGY.....	271
Wave Dominated - young.....	271

Transitional - young.....	271
Tide-Dominated.....	273
Transitional - old.....	273
Wave Dominated -old	274
TIDAL INLET LOCATION.....	274
Inlets In Flanking Barrier Islands.....	274
Inlets Along The Barrier Shoreline.....	280
Tidal Inlet Evolution, Barataria Bight.....	280
Inlet Deterioration In A Flanking Barrier Shoreline.....	282
Inlets Within Barrier Island Arcs.....	285
CONCLUSIONS.....	286
 11. TIDAL INLET INFLUENCE ON BARATARIA	
BARRIER EROSION	293
 INTRODUCTION.....	293
Objectives.....	293
PASS ABEL DATA.....	294
Pass Abel - Geomorphology.....	294
Pass Abel - Stratigraphy.....	294
Pass Abel - Map History	296
1817.....	296
1841	296
1887	299
1937.....	299
1973	299
1983.....	299
QUATRE BAYOU PASS DATA	302
Quatre Bayou Pass - Geomorphology	302
Quatre Bayou Pass - Stratigraphy.....	305
Quatre Bayou Pass - Map History.....	305
1817	305
1842	305
1883/1886.....	306
1934	306
1981	307
PASS RONQUILLE DATA.....	307
Pass Ronquille - Geomorphology.....	307
Pass Ronquille - Stratigraphy.....	310
Pass Ronquille - Map History.....	310
1841	310
1886	310
1934	311
1982	311
DISCUSSION	311
Inlets in Low Profile Flanking Barriers.....	311
Pass Ronquille	311
Pass Abel	312
Inlets Occupying Antecedent Distributary Channels.....	312
Inlet Migration.....	314

Processes Contributing to Inlet Widening.....	319
Barataria Shoreline Short Term Future.....	324
Coastal Land Management Considerations.....	324
CONCLUSIONS.....	325
12. COLLECTIVE DISSERTATION CONCLUSIONS.....	328
13. EXECUTIVE SUMMARY.....	332
REFERENCES.....	334
APPENDIX I: List of Historical Maps.....	349
APPENDIX II: Sediment grain size statistics.....	350
VITA.....	356

List of Tables

Table	Page
1. Listing of Carbon-14 samples analyzed for this program. Samples PAS-1 and QBP-B-2 contained transported shelly material. The remaining samples were comprised of in-situ rooted material.	30
2. The depositional characteristics associated with various facies.	38
3. The distance and projected duration of three transgressions that occurred in the Barataria region.	235
4. The chronology of delta lobe progradations and transgressions occurring in the Barataria region up to about 5000 ybp.	247
5. Barataria Bay open water area increase between 1891 and 1978.	284
6. The temporal increase of pass width at Barataria Pass, Quatre Bayou Pass, and Pass Abel.	284
7. Temporal changes in inlet cross-sectional area at Barataria Pass, Quatre Bayou Pass, and at Pass Abel.	284
8. Parameters associated with inlet type in abandoned delta lobes.	288

List of Figures

Figure	Page
1. Location map of Holocene Mississippi River Delta Plain, southeastern Louisiana (From Penland and Boyd, 1985).	2
2. Frazier's (1967) map chronology of the Mississippi River Delta Plain. The Mississippi River Delta Plain is the product of several coalescing delta lobes. The Maringouin was deposited first, then the Teche, St. Bernard, and so on... The Barataria area was affected by lobes 6,7,10 and 13.	3
3. Remnants of past Mississippi River delta lobes are found along the delta plain as 1) erosional headlands with flanking barriers, 2) barrier island arc systems, and 3) inner shelf shoals (From Penland and Suter, 1983).	4
4. An evolutionary model depicting the three stages of deterioration in an abandoned delta lobe. (From Penland and Boyd, 1981).	6
5. Location map of study area. Field data for this study was collected from the shaded, inset area. Regional geologic data sets allowed the larger bracketed area to be studied. The coastwise range of this study runs from the Caminada-Moreau Headland east to the Mississippi River in Nairns, Louisiana. Also encompasses from 12 km seaward of the present shoreline to approximately 9 km landward. The two lines of barrier ridges dashed in this figure were identified by Welder (1959).	8
6. Location map of eastern Barataria shoreline area. Barataria Headland and Pass Ronquille are labeled as such for purposes of this research only. These names have not been formally adapted by any governmental mapping agency.	10
7. Wave energy diagram from Mossa et al. (1985). The dominant deepwater wave approach is from the eastern compass quadrant.	12
8. Penland and Boyd (1985) speculated that the Grand Terre barrier system was simply a product of headland erosion from Robinson Bayou.	14

Figure	Page
9. Location of offshore cores and seismic information used in this research. This data was collected by the Louisiana Geologic Survey in 1983. A total of Twenty-six 10 m vibracores and 90 km of high resolution seismic data was gathered.	19
10. Core location map for onshore data set. A total of fifty-eight cores were taken with an average length of 6.0 m.	23
11. Key to symbols used to denote the characteristics of the cores. The alpha abbreviations designate facies types interpreted from the core characteristics.	31
12. Photograph of BF (Bayfill) facies in core QBP-S-2. Noteworthy are the single round, sand filled burrow at interval 250 and the millimeter thick beds of silt within the overall clay matrix.	34
13. X-ray radiograph of clay dominated BF, bayfill facies, QBP-B-1. Ripples superimposed on ripples are evident in the middle column above the 10 cm interval. A horizon of root filaments is also noted in the center column just beneath the 20 cm label.	35
14. Diagrams of sequences that include bayfill units in the Barataria cores. Note the predominance of burrowed bay clays at the base and the variety of erosional and rapid gradational contacts above the bayfill facies.	36
15. Channel mouth depositional environments.	39
16. Diagrams of delta front sequences described in core. A variety of lithologic, bedding, faunal and organic features were seen within this component of the delta lobe.	42
17. X-Ray Radiograph of QBP-C-2. The right column contains examples of trough-cross bedding and ripple-bedding described in Barataria core delta front lithofacies.	43

Figure	Page
18. X-Ray Radiograph QBP-C-2. The bedded sequence has been burrowed extensively. The burrowing indicates decreased sedimentation rates interpreted as occurring at the flanks of the prograding delta lobe.	44
19. Core photograph QBP-B-5. Interval 590 cm to 540 cm illustrates coarsening upward delta front facies with seams of organic detritus.	46
20. Core log CR-11. This thick delta front sequence was unaffected by adjacent channel deposits and is capped by marsh and bay environments.	47
21. Log Core PAE-5. An active channel sequence begins at 5.8 m and is abandoned at 3.2 m. The abandoned channel fill above core interval 3.2 grades to marsh.	50
22. Photograph Core QBP-C-2. Interval 380 cm to 230 cm contains an exemplary sequence of the three channel sub-units; Active, lower abandoned and upper abandoned.	51
23. Diagrams of channel and channel fill sequences described in core. Note the variety of basal contact from sharp erosional (CR-6) to gradational (PAE-5). Channel fills are normally organic rich.	52
24. Photograph Core QBP-B-1. Note channel sequence between interval 280 cm to 80 cm. Immature, gray sands are found from 240 cm to 200 cm.	54
25. Photograph Core QBP-C-2. The middle segment is comprised entirely of rafted organic/woody detritus.	56
26. Core photograph of the base of PAN-4. The organic streaked, ripple bedded sandy/silts (4.6 to 4.75 m) have been interpreted as a channel-side subaqueous levee.	61

Figure	Page
27. Core photograph of QBP-B-7. The distorted, organic streaked sands (5.7 to 5.9 m) have been interpreted as proximal overbank.	62
28. Diagrams of proximal overbank sequences described in core.	63
29. Diagrams of distal overbank sequences described in core.	64
30. Core photograph QBP-N-3. A normally graded levee sequence fines from proximal overbank, bedded sands (4.5 to 5.0 m) to distal overbank, rooted, burrowed clays (2.0 to 3.5 m).	66
31. Photograph of overbank sequence in the middle segment of QBP-C-4. The spectrum of hues in this photograph suggests a variety of processes affects the overbank depositional sequence.	67
32. Geologic cross-section from PAN-4 to PAN-2, illustrating a lateral decrease in primary structure and sediment size with distance from the channel located just west of PAN-4.	68
33. Core photograph PAE-4 ; the center column. Only the disarticulated shell valve disrupts the otherwise homogeneous appearance of the bay interval.	72
34 a and b. Diagrams of described bay sequences from Barataria cores.	73
35. X-ray radiograph core PAE-2/3. The clay matrix contains abundant disarticulated <u>mulinia</u> sp. valves.	74
36. X-ray radiograph core QBP-B-7. Note that this bay sequence is nearly void of shell material. right column 3.30 m to 3.00 m, bay, center 3.00 m to 2.70 m, transition bay to overbank; 2.70 to 2.40 m, distal overbank.	75

Figure	Page
37. Core photograph PAN-4. The top meter of the core demonstrates a gradational change from interdistributary bay to flood tidal delta.	77
38. Core photograph PAN-2. The fine-grained interdistributary bay sequence (2.5 to 0.5 m) records a coarsening upward (0.5 m to surface) as a flood tidal delta migrates landward over it.	78
39. Core photograph PAE-1. The contact is between marsh and an overlying interdistributary bay. Relative sea level rise was too rapid for the marsh vegetation to keep pace.	79
40. Core photograph PAS-6. The seam of shelly material observed at Interval 1.55 m is a lag accumulated by wave winnowing of the bay facies.	81
41. Illustrated examples of Barataria cores that include backbarrier units.	84
42. X-ray radiograph of core PAS-6, interval 230 - 200 cm. The rightmost column shows thin seams of bedded shells within the lagoonal unit. Coarser, thicker and more frequent shell seams atop this lower unit (center column) are part of a landward migrating barrier. Pass sediments cap this sequence (left most column).	85
43. Photograph core CRD-5, interval 570 - 540 cm. These units contain minimal shell material but were still interpreted as backbarrier.	86
44. Photograph core CRD-5, interval 170 - 152 cm. The humic staining within this coarse backbarrier unit is the result of decayed vegetation.	88
45. Photograph core CRC-1. Peaty marsh, 300 - 270 cm is overlain by bay (270 - 210 cm), backbarrier 210 - 60 cm, and then barrier from 60 - 0 cm.	89

Figure	Page
46. X-ray radiograph of core CRD-4, interval 120 to 60 cm. Organic rich peat (Interval 120 - 90 cm), shelly, sandy clay backbarrier (90 - 60 cm) and burrowed sandy pass floor which is relatively devoid of shell material (60 - 30 cm).	90
47. Profile of low-profile barrier and typical morphological zonation. (Modified from Morton, 1979).	94
48. X-ray radiograph of marsh unit. The left two columns are spartina/root mottled marsh from core PAS-1, interval 2.00 m to 1.05 m. The coarsest roots are observed toward the top of the marsh, which is buried beneath a sandy spit.	96
49. Illustrated examples of low marsh sequence basal contacts.	97
50. Illustrated examples of low marsh sequence upper contacts.	98
51. Core photograph CRD-4. Note sequence from interval 1.2 m to surface where a marsh is flooded by the overlying bay (1.0 m) and then the pass floor (0.4 m).	100
52. Distribution of depositional environments within the Barataria shoreline area.	101
53. Inlet affiliated recurved spit components (modified from Boothroyd, 1978).	103
54. Diagram of Grande Terre recurve spit impinging upon the Pass Abel channel. Dominant eastward longshore sediment transport is causing the middle reach of the inlet channel to bow slightly to the east.	105
55. Diagram of spit sequences described in the Barataria cores. In most cases the coarser, sandy spit units was preceded by a fine-grained depositional environment. Core PAE-1 and PAW-2 contained the only examples of spit facies preserved in the subsurface.	106

Figure	Page
56. Core Photograph of PAN-6. The upper 4.5 m of this major spit sequence contains alternating intervals of horizontally bedded sands and shells.	107
57. Core Photograph PAS-1. The sharp erosional contact between lower finer grained lithologies and the sandier spit (interval 1.20 m) is commonplace in this suite of cores. The burrowed sandy units between 1.20m and 0.5m probably represent the subtidal spit platform.	108
58. Bathymetric profiles across the eastern Barataria inlets. Both Pass Abel and Quatre Bayou Pass have narrow deep thalwegs on their western side. The majority of the pass throat is dominated by a shallow platform.	110
59. Examples of pass platform sequences described in the Barataria cores.	111
60. Core photograph CRD-4. The pass platform sands are only 0.4 m thick, lying over burrowed, bay clays.	112
61. Core photograph PAN-5; interval 1.55 - 1.20 m. Horizontally bedded sands and shells are common attributes of the platform sands.	113
62. Oblique aerial photograph of Pass Ronquille. The sandy flood tidal delta lobes are formed by the combined flood currents and Gulf generated waves.	115
63. Core photograph PAN-3; interval 0.3 - 0 m. The upward increase in shell size and content is typical of the flood tidal delta unit.	116
64. Diagrammatic examples of flood tidal delta sequences.	117
65. Diagrammatic examples of channel margins.	119

Figure	Page
66. Core photograph CRB-6. The sharp contact at 0.5 m suggests that the channel margin floods on occasion causing a temporary widening of the pass.	121
67. Diagram of barrier shoreline components. The barrier/beach is located in the foreshore zone between the berm crest and the low-tide terrace.	122
68. Diagram of barrier sequences described in the Barataria suite of cores.	124
69. Core photograph PAW-2. Note the seventy centimeter veneer of sand which has buried a vegetated backshore unit. The sandy unit contains a large vertical burrow.	125
70. Core photograph PAW-1. The lower barrier unit 3.70 m to 1.70 m lies below a backbarrier marsh (1.7 to 0.7 m), which is capped by the present (70 - 0 cm) beach of Grand Terre. Note the humic staining that has stained the location of a dissolved root (2.2 to 2.0 m).	126
71. Core logs of barrier sections in cores PAW-2 and CR-5. The spartina rooted sands in core CR-5 were recovered at a depth of -5.0 m MSL. This is the deepest example of a beach ridge recovered in this suite of cores.	129
72. Transect A-A'. Periods of transgression are not well preserved and are defined primarily as contacts. Parasequence F-Tr is proposed to be the transgressive component of the des Families delta lobe.	131
73. East to west seismic line in the vicinity of Core 38. A reflector at approximately -9 m may define the F-Tr, Families Transgression. Consult figure 9 for data location.	135
74. Transect B-B'. This cross-section exhibits three packets of regressive sediments separated by contacts that are proposed to represent transgressive events.	137

Figure	Page
75. East to West Seismic records that show a channel feature in the vicinity of core 10. A smaller channel appears to be "piggy-backed" within a deeper, larger channel. BB-Tr may represent a tidal inlet deposit. Consult figure 9 for data location.	140
76. East to West Seismic records show a channel feature in the vicinity of core 9. Consult figure 9 for data location.	141
77. Transect Dip C-C'. Three periods of delta lobe progradation are separated by two transgressions. Bayou des Families (F-Re) is the deepest recorded delta progradation.	144
78. Bathymetric profile from Manilla Pt., Barataria Bay to Grande Terre and offshore to approximately 14 m depth. Note that there does not appear to be a leveling of the shoreface at the proposed 9 m limit of wave base.	148
79. North to South Dip seismic section in vicinity of core 14. The seaward sloping shelf intersects horizontal subsurface reflectors approximately 2.0 km offshore in 5 m of water.	149
80. Locations of cores taken in the Pass Abel area.	152
81. Transect PAN. Overbank deposits in sequence BB-Re exhibit decreased bed shear effects with distance from Pass Abel channel. Pass Abel was probably a distributary during the Bayou Blue Progradation.	153
82. Transect PAT-3 to PAN-5. Proximal overbank deposits on either side of Pass Abel in sequence MS-Re, -2.5 to -2.0 m, suggest that the Pass Abel channel was also the site of a Mississippi Lobe distributary.	154
83. Transect PAE. The dated marsh at the top of core E-2/3 defines the latest period of activity for Bayou Blue. The landward limit of the Bayou Blue Transgression (BB-Tr) is located between E-2/3 and E-4.	160

Figure	Page
84. Dip cross-section PAE-C'. This cross-section reveals the horizontal contacts between parasequences. The nature of the contacts and the depth that they occur are evidence that these are bay ravinement surfaces.	161
85. Transect PAW. This transect was taken across the eastern side of Grande Terre Barrier Island. The Modern C-14 date at -1.0 m in core PAW-1 marks top of the Mississippi Lobe progradation and the inception of the modern transgression over barriers formed during the Mississippi Transgression.	164
86. Core PAS-2. Two periods of active channel sedimentation are exhibited in this core. BB-Re in the lower section -5.5 to -3.4, and Ms-Re from -3.4 to -2.0. These channels are separated by BB-Tr, the Bayou Blue transgression.	165
87. Transect PAS-1 to PAT-3. BB-Re and MS-Re are separated by the Bayou Blue Transgression. A shell lag dated 3700 ybp, at -3.4 m helped to define this event stratigraphically.	166
88. Location of cores taken in Quatre Bayou Pass area.	172
89. Transect QBP-B. In core B-2, a transgressive shell lag dated 3700 ybp separates BB-Re and Ms-Re. The landward limit of this transgression is located between core B-4 and B-5. A C-14 date acquired from in-situ vegetation in core B-4 shows that the Ms-Re Progradation occurred around 700 ybp.	173
90. Transect QBP-S. Diminishing bed shear is noted distally from the Quatre Bayou Pass channel in sequence BB-Re. This is evidence that a Bayou Blue distributary flowed through the present channel location.	178

Figure	Page
91. Transect QBP-C. The Bayou Blue progradation (BB-Re) is encountered deep in cores C-4 and C-5.	182
92. Transect QBP-D. The intercalated beds of shells and sands in sequence BB-Re are part of the transgressive component of the Bayou Blue delta lobe.	185
93. Location of cores taken in the Pass Ronquille area.	188
94. Transect CR-C. Sequence MS-Re is capped by another minor progradation designated (L) MS-Re-Re. In core C-6, Ms-Tr may be a tidal inlet fill from the Mississippi Transgression.	189
95. Transect CR-B. Sequence (L) MS-Re is thicker on either end of this east/west transect.	194
96. Transect CR-D. The coarse shelly sands in parasequence BB-Tr are probably flood tidal deltas and components of a barrier shoreline that once protected this part of the coast.	198
97. Transect CR. The vegetated sand ridge beneath core CR-5 defines a flank of the Bayou Blue barrier shoreline. Sequence Ms-Re contains two meter thick active channel deposits. C-14 of roots within these deposits (CR-1) places its occurrence at 400 ybp. The landward cores of this transect, 8, 9, and 11, cross a lobe of a crevasse splay observed on 19th century maps.	202
98. Quatre Bayou Pass, 1841. A crevasse splay formed through a breach of Cat Bayou covers the floor of Bay Long.	206
99. Frazier's cross-section D-D. Frazier's program only reported results to -14 m. According to Frazier's interpretation the Bayou des Families lobe lies over the Bayou Terre aux Boeuf delta lobe.	209
100. Frazier's lobe 7, depicting Bayou des Families progradation.	210

Figure	Page
101. Frazier's (1967) early delta lobes 5 and 6, Bayou Terre aux Boeuf and Bayou Terrebone. Terre aux Boeuf is proposed to be the first holocene delta lobe to build into the Barataria area.	212
102. Frazier's (1967) cross-section D-D' simplified. The landward limit of the Families transgression is implied from the curvature of the contact between lobes 7 (des Families and lobe 10 (Bayou Blue).	214
103. Frazier's lobe 10, Bayou Blue progradation.	215
104. Geologic cross-section from the Caminada Headland to Point Chenier Ronquille. The inlet sands beneath cores CRD-1 and CRD-3 are located landward of the old Bayou Blue barrier shoreline.	217
105. Gerdes (1983) cross-section across the Caminada/Moreau Headland. The limit of the Bayou Blue transgression lies between Gerdes core designation 39 and 32.	221
106. C-14 dates plotted across the proposed limit of BB-Tr. The 1970 ybp dates are near the Barataria headland, the area of Bayou Blue distributary origination. Transgressive shell lags dated 3700 ybp lie stratigraphically higher than the earlier dates.	222
107. Frazier's Lobe 13, the Mississippi Lobe progradation.	224
108. C-14 dates later than 1000 YBP plotted across the Barataria shoreline map. The 710 and 860 ybp dates mark the Mississippi Lobe progradation. The later dates nearer Chenier Ronquille are proposed to represent an eastern sub-lobe of the Mississippi lobe.	226
109. Map of southeastern Louisiana by Leach and Turtle, 1887. The shaded regions depict distributaries of the eastern sub-lobe of the Mississippi Lobe progradation. The eastern most channel runs along the mid-axis of Bay Long.	227

Figure	Page
110. Map of Plaquemines shoreline including Grand Terre. In older aerial photos the beach ridge orientation on Grand Terre suggests that it grew from eastward located sediment sources.	229
111. Summary diagram of delta lobe chronology in the Barataria Vicinity 5000 YBP to present.	230
112. Present rates of shoreline change along the Barataria shoreline (From Mossa et al., 1985).	232
113. Landward limits of transgressions occurring in the Barataria Bight region. The Families transgressive limit is interpreted to be part of the bay ravinement surface. The Bayou Blue transgressive limit is positioned slightly landward of a related barrier shoreline. The Mississippi/Modern transgression contact is defined by the surfzone of the present shoreline.	234
114. The Mississippi Delta Plain. With the exception of the Barataria Bight region all other transgressive portions of this shoreline are concave (the apex of the curvature pointed landward).	238
115. 1816 map of southeastern Louisiana, Barataria Bay. The north/south elongate shape suggests that it is located between two narrow delta lobes. There is no opening in the area where Pass Abel is now located.	240
116. Barataria Bay prior to the Mississippi and Late Lafourche progradations.	241
117. Longshore sediment transport trends in the vicinity of the Caminada Moreau headland (from Gerdes, 1985).	243
118. Comparison between Frazier's delta (1967) lobe chronology and the new chronology, modified by this dissertation research.	245

Figure	Page
119. Sea Level rise measured at the Bayou Rigaud tide gauge in the Grand Isle vicinity from 1950 through 1980. Sea Level rose at a rate of 1.5 cm/yr during this time period.	249
120. Plot of C-14 dates taken from the Barataria/Caminada shoreline area vs. depth. The curvilinear trend of the Barataria Bay samples suggests that rates of subsidence decrease with depth.	251
121. Plot of 235 C-14 dates vs. depth for samples taken from the Mississippi River delta plain. The curvilinear trend of this data matches that of the small dataset collected for the Barataria study.	253
122. Plot of apparent rates of subsidence vs. depth. At depths <1 m variance is the greatest. This plot suggests that regional differences in surficial geology contribute to high initial rates of relative sea level rise.	255
123. a. Modified sea level curve based upon the joining of Colquhoun (1981) and Rhode (1978) data. b. Late Holocene sea level curve for the Barataria Region of Louisiana derived from the dissertation data.	258
124. Tidal inlet variability and distribution along the Mississippi River delta barrier shoreline.	272
125. Quatre Bayou Pass a:1841, b: 1883, c: 1934. Note the shift in the channel thalweg from the east side of the pass to the west. The marsh break-up in 1883 precedes the change in channel location. Pass Ronquille is not present in these maps until 1883, when it is somewhat incorporated into the Quatre Bayou Pass opening. In 1934 recurve spits are observed pointing landward into Bay Long from Pass Ronquille.	275
126. Diagram of Barataria Pass. Tide-dominated features include a well developed ebb-tidal delta, main-ebb-channel and marginal flood channels.	276

xxx

Figure	Page
127. Little Pass Timbalier, 1956. This is an older transitional tidal inlet. The main ebb channel is filling and the terminal lobe of the ebb-delta is being pushed landward. Inlet channel shoals are actually remnants of old recurve spits that once confined the inlet channel.	277
128. Summary diagram of tidal inlet evolution in a deteriorating delta lobe. As bay area increases in a stage 1 barrier, tidal prism through the inlet increases. This causes the inlet to evolve from wave to tide-dominated. When the sediment supply to the inlet becomes limiting, even though the bay continues to increase, numerous leaks through and around the barrier results in decreased through-the-inlet tidal prism. The inlet subsequently evolves from a tide to wave-dominated morphology.	278
129. Inlet evolution in Eastern Barataria shoreline. Barataria Pass has been a tide-dominated inlet since 1887 (and probably earlier). Pass Abel was first an ephemeral, wave-dominated inlet before becoming permanently established around 1934. Quatre Bayou Pass has evolved from a small transitional inlet-type to a tide-dominated between 1841 and 1956. Pass Ronquille did not form until 1934. The tidal prism of Pass Ronquille is increasing due to the marsh breakup in the back bay. Tidal prism from Barataria Bay is being captured by Ronquille Bay and Bay Long.	281
130. Oblique aerial photographs of older transitional and wave dominated inlets of the Chandeleur Barrier Island arc system. A. The main ebb channel is being filled by sediments derived from longshore and ebb-delta sources.	290
B. an older wave-dominated delta with a sub-tidal flood delta.	291
131. Circuit of tidal inlet evolution superimposed upon Nummedal and Hayes (1978) plot of inlet morphology as a function of tidal height and wave height.	292

Figure	Page
132. Pass Abel bathymetric profile. The deep narrow channel contains 12 per cent of the pass width, but nearly forty percent of the channel cross-sectional area.	295
133. Pass Abel, 1817. The eastern side of Grand Terre is breached in the general vicinity of Pass Abel. An intertidal shoal is depicted on the landward side of the pass opening. Quatre Bayou Pass, 1817. This old, large scale map shows an opening at the position of Quatre Bayou Pass. Lack of detail precludes any observation other than its general presence.	297
134. Grande Terre Barrier, 1841. Pass Abel is designated as "Cut Off" in this early shoreline map of Grande Terre.	298
135. Pass Abel, 1937. Two small channels incise the flood-tidal delta. These channels deepen to 4 meters at the inlet throat before shallowing against the ebb-tidal delta.	300
136. Pass Abel, 1971. The central shoal of Pass Abel in this map is actually a fragmented piece of Grande Terre.	301
137. Aerial photograph of Pass Abel, 1983. The crest of the flood tidal delta is visible in this photograph. The inlet thalweg hugs the eastern shoreline.	303
138. Quatre Bayou Pass bathymetric profile. Even though the channel area comprises only 25 % of the pass width, it contains nearly 60 % of the total inlet cross-sectional area.	304
139. Quatre Bayou Pass, 1981. Since 1934 the Pass opening of Quatre Bayou has been pushed nearly a kilometer landward. The 1981 channel thalweg is straighter than that depicted in the 1934 map.	308
140. Pass Ronquille bathymetric profile	309

Figure	Page
141. Pivot of Barataria Pass inlet throat (From Shamban, 1985). Barataria Pass is not migrating coastwise. As the shoreline recedes the inlet throat is being resituated in a meander bend of an old distributary system.	316
142. Repositioning of inlet throat during shoreline retreat. The westward migration of a distributary-located-inlet is controlled by the antecedent channel axis position.	318
143. Changes in width (a) and channel cross-sectional area (b) at QBP (from Howard, 1983). Around the turn of the century the channel cross-section has not increased significantly while the shallow platform width has quadrupled. During the same period of time the total pass cross-section has increased dramatically since around 1940.	321
144. Diagram of inlet x-section modification by lateral planation of barrier Islands. The non-migratory nature of the deep channel margin causes the shallow barrier sands to be swept off of the fine-grained platform to increase the overall channel cross-sectional area.	323
145. Location of new Barataria shoreline following complete erasure of the present barrier system. Successive bay/shoreface transgressions would have inlet scars separated by the open water dimension of the ancestral bay.	327

ABSTRACT

At least three delta progradations have contributed to the Barataria geologic framework since 5000 ybp. The Bayou des Families lobe was first (4600 to 3600 ybp) followed by Bayou Blue (2600 and 1900 ybp) and then the Mississippi lobe (1000 ybp to the present).

A flooding surface separates the (lower) Bayou des Families from the Bayou Blue progradation (above). The shoreface of the Bayou des Families transgression lies seaward of the present Barataria shoreline. This transgression lasted approximately one thousand years. A flooding surface also separates the Bayou Blue progradation from the Mississippi Delta lobe. This (Bayou Blue) transgression lasted 900 years, was halted near the present shoreline, and can be traced from the Caminada headland to the meander bend of the Mississippi River at Nairns, Louisiana.

Rates of relative sea level rise recorded in the subsurface of the Mississippi River delta plain decrease from 1.0 cm/yr in the top meter to less than 0.20 cm/yr at three meters. In recently abandoned delta lobes the high initial rate of subsidence contributes to rapid increases in bay area and tidal prism. This increase has caused the Barataria tidal inlets to evolve from wave-dominated to tide-dominated inlets within the past 150 years. In the late stages of delta lobe abandonment sediment supply to barriers islands becomes critically low. The inlets widen causing tidal currents to

decrease. This causes the once tide-dominated inlets to become wave influenced.

Dynamic coastal processes in the bays, inlets, and on the shoreface all contribute to the low preservation potential for Barataria shoreline sediments following the present transgression. Preservation, if any, will be limited to inlet channels scoured beneath the shoreface depth. The processes occurring along the Barataria shoreline are probably similar to those that occurred during past Holocene delta plain transgressions.

By understanding the links between landloss and tidal inlet evolution during delta lobe abandonment the success of future Barataria barrier shoreline preservation programs may be improved. Bay area reduction by wetland restoration may reduce tidal currents through an inlet/barrier system. This activity combined with sand nourishment of the barrier shoreline should help save the Barataria Bay ecosystem.

1. INTRODUCTION

THE DELTA CYCLE

The literature is replete with information regarding the progradational phase of the deltaic cycle (Fisher et al., 1969; Coleman and Wright, 1975; Galloway, 1975; Coleman, 1981). The respective river/delta system deposits a lobe of sediment with a morphology influenced by the regional geology, tectonics, climate, and physical processes (waves and tides) indigenous to the receiving basin (Wright et al., 1974; Coleman and Wright, 1975). When the distributary is no longer an efficient pathway for the parent river it may change its course and empty into adjacent interdistributary regions. This delta switching process has occurred a number of times during the late Holocene in the Mississippi River delta plain of southern Louisiana (Figure 1), each time building a new lobe of sediments onto the shallow shelf (Russell, 1936; Fisk, 1944; Kolb and Van Lopik, 1958; Frazier, 1967). The coalescence of sixteen distinct delta lobes deposited during the past 7500 years comprises the Mississippi River deltaic plain (Figure 2) (Fisk, 1944; Frazier, 1967). Remnants of past Mississippi River delta lobes occur within the delta plain, along the coast and on the shelf as major sand bodies of various morphologies and geometries (Figure 3). The most recently abandoned lobes (Late Lafourche and Plaquemines)

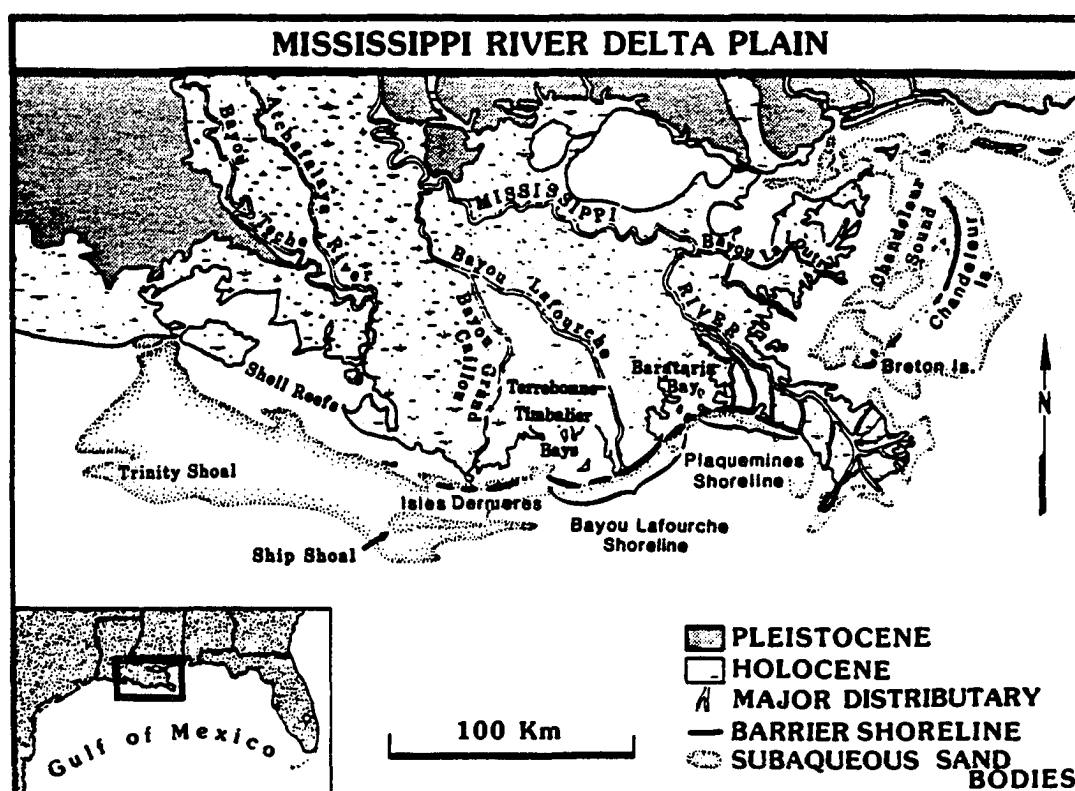


Figure 1. Location map of Holocene Mississippi River Delta Plain, southeastern Louisiana (From Penland and Boyd, 1985).

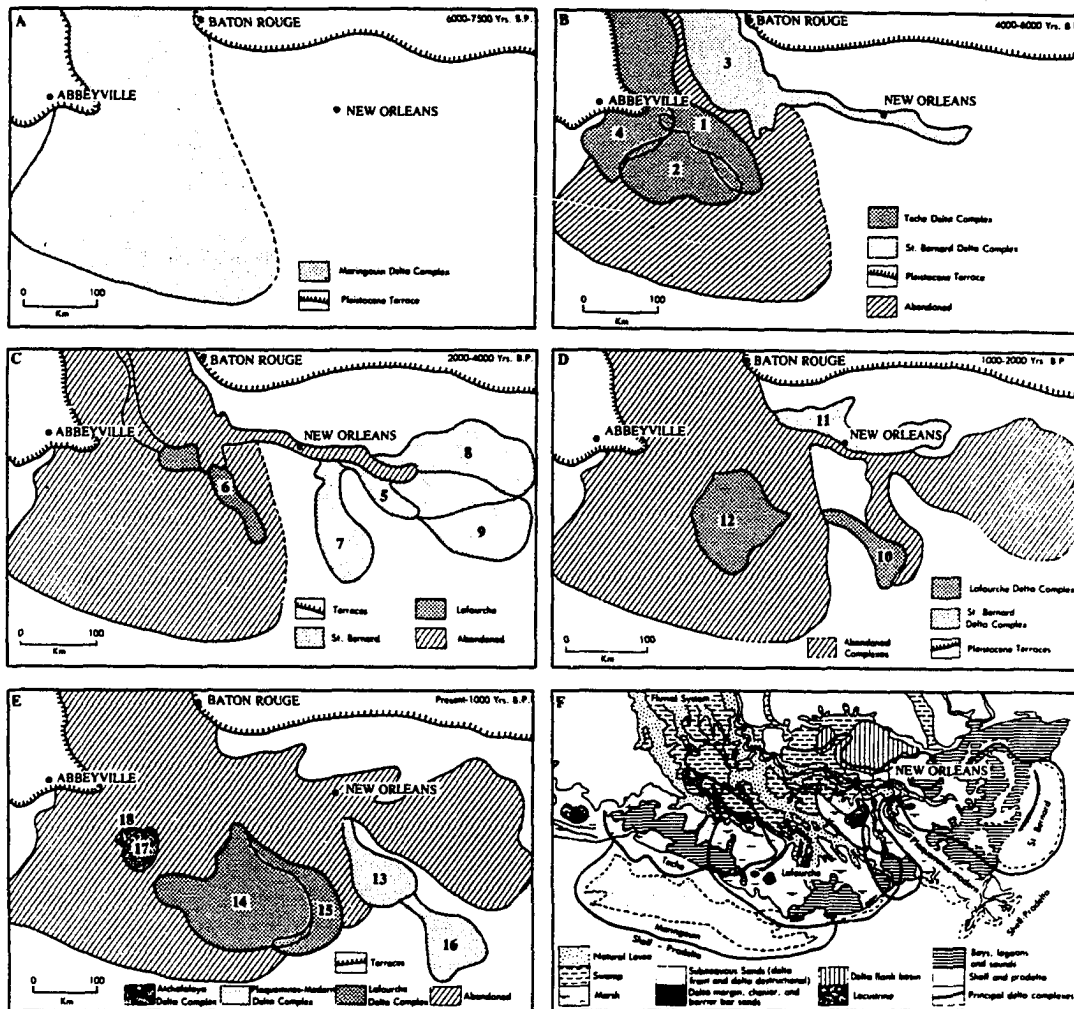


Figure 2. Frazier's (1967) map chronology of the Mississippi River Delta Plain. The Mississippi River Delta Plain is the product of several coalescing delta lobes. The Maringouin was deposited first, then the Teche, St. Bernard, and so on... The Barataria area was affected by lobes 6,7,10 and 13.

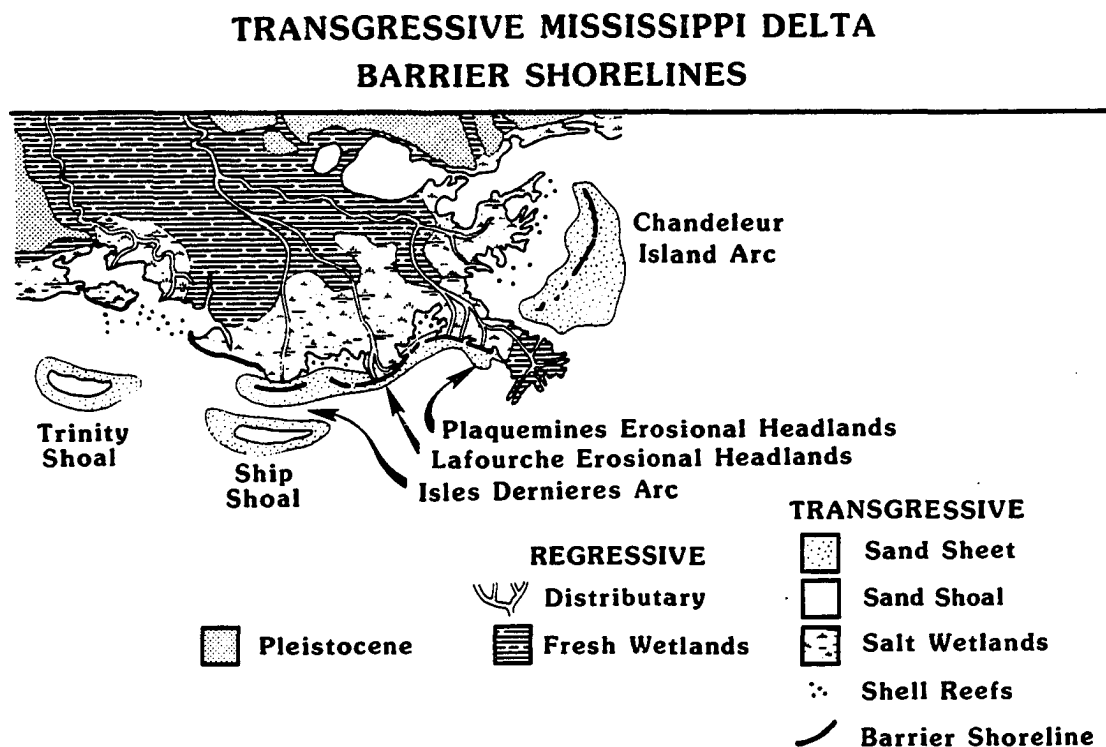


Figure 3. Remnants of past Mississippi River delta lobes are found along the delta plain as 1) erosional headlands with flanking barriers, 2) barrier island arc systems, and 3) inner shelf shoals (From Penland and Suter, 1983).

exhibit erosional headlands with flanking spits and barrier islands. The next oldest lobes, the Early Lafourche and St. Bernard, are represented by the Isles Dernieres and Chandeleur barrier island arc systems, respectively. Older deltas yet, such as the Maringouin are represented as inner-shelf shoals (Nummedal et al., 1984). Penland and Boyd (1981) articulated the correlation between sand body geometries and the stage of deterioration in the abandoned delta lobes (Figure 4).

Once an active delta lobe is abandoned land loss is accelerated due to the additive effects of deltaic sediment compaction and loss of the distributary sediment source (Scruton, 1960). In the absence of sediment supply, delta plain subsidence causes interdistributary bays to form and expand. As the bays' open water area increases waves erode their perimeters causing further expansion (Tubb, 1972; Anderson, 1974). Concurrently, ocean waves erode the deltaic headland distributing delta front sands laterally across the front of the interdistributary bays (Morgan, 1967). This set of events represents the eroding headland/flanking barrier stage of Penland and Boyd's (1981) barrier island model (Figure 4) and the beginning of the delta lobe's transgressive phase. Lateral growth of barriers fed by the abandoned headland commonly cause beach ridges to build seaward (Morton and Nummedal, 1982). The second stage occurs when the headland from which the barrier sediments

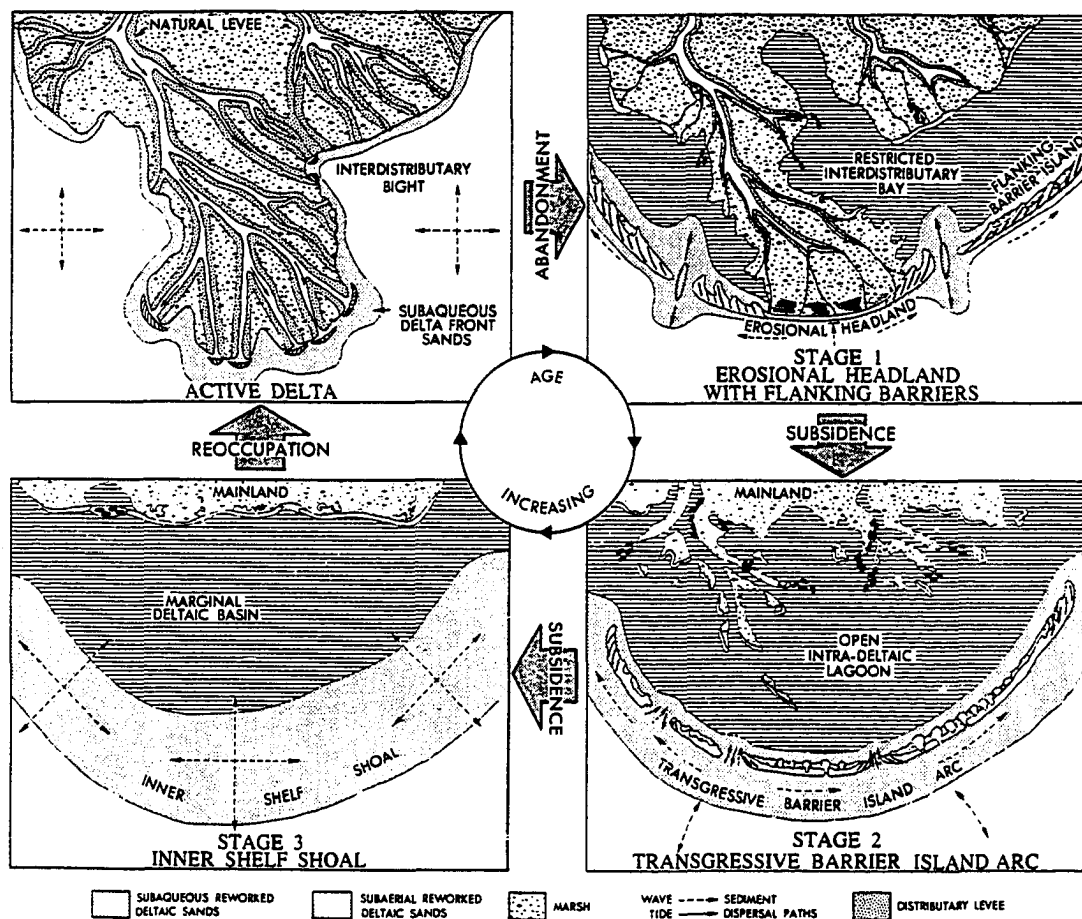


Figure 4. An evolutionary model depicting the three stages of deterioration in an abandoned delta lobe. (From Penland and Boyd, 1981).

are derived, becomes submerged and detached from the barrier system. The barrier system has, at this point, become transgressive. The finite amount of sand contained in the closed barrier island arc system is continuously reworked by marine processes. Coastal erosion combined with relative sea level rise results in the loss of subaerial barrier island components. The barrier becomes increasingly subaqueous and eventually evolves into sub-tidal inner-shelf shoals (Penland and Boyd, 1981). A dynamic, predictable, evolutionary cycle of tidal inlet change accompanies this cycle of barrier island development in the Mississippi River delta plain (Levin et al., 1983).

STUDY AREA LOCATION

The focus of this study is the southeastern coastal section of Louisiana just west of the modern Mississippi River Delta (Figure 5). Field data collection was concentrated within a ten kilometer stretch of the eastern Barataria shoreline, located, between 89 55'00" and 89 47'00" Longitude and 29 17'30" and 29 20'00" Latitude from the eastern end of Grand Terre Island to Point Chenier Ronquille. Three tidal inlets are located within this section of barrier shoreline. From west to east they are Pass Abel, Quatre Bayou Pass, and Pass Ronquille. Pass Ronquille has not been formally labeled as such on any coastal charts or maps. This designation is used to

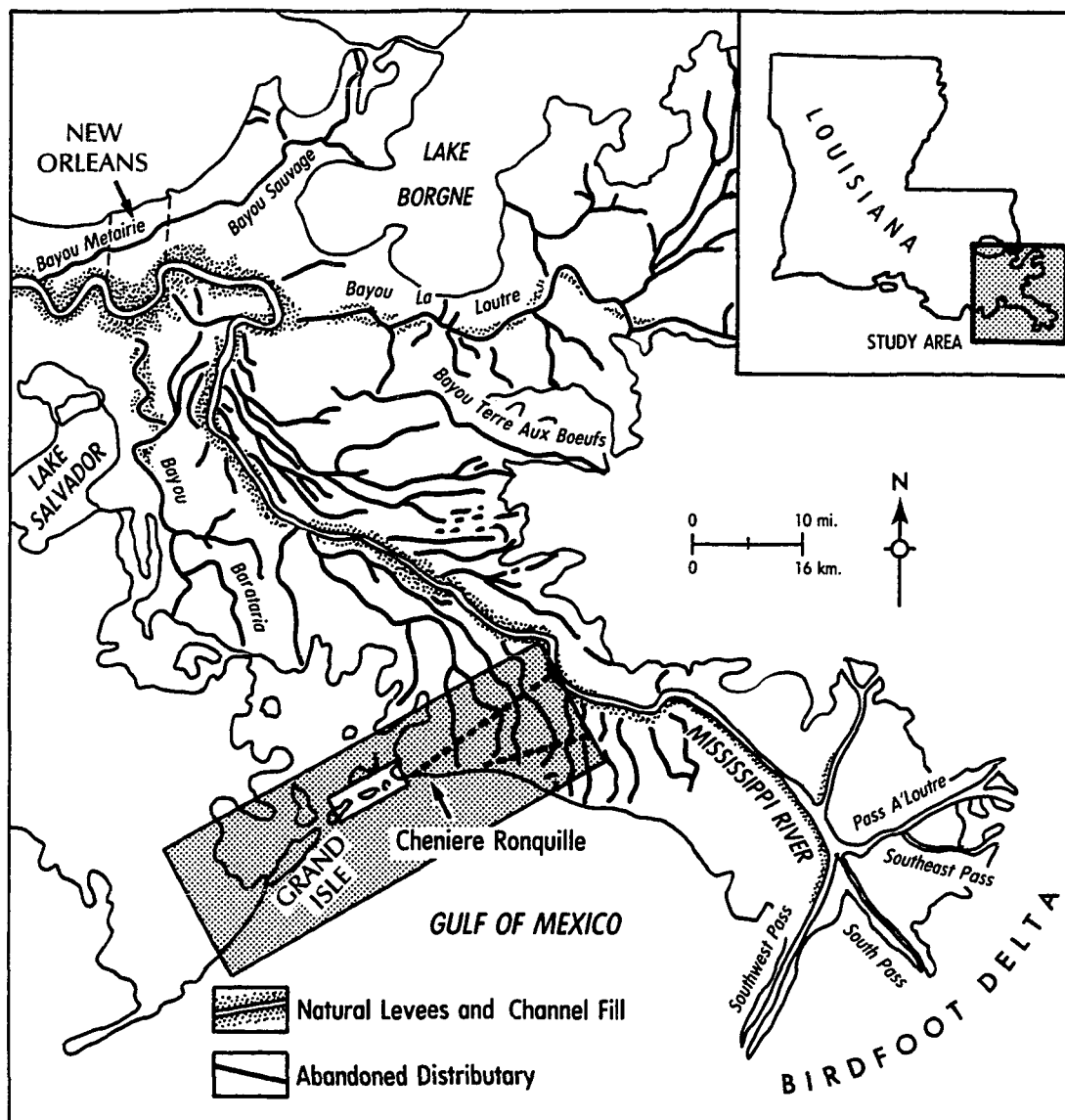


Figure 5. Location map of study area. Field data for this study was collected from the shaded, inset area. Regional geologic data sets allowed the larger bracketed area to be studied. The coastwise range of this study runs from the Caminada-Moreau Headland east to the Mississippi River in Nairns, Louisiana. Also encompasses from 12 km seaward of the present shoreline to approximately 9 km landward. The two lines of barrier ridges dashed in this figure were identified by Welder (1959).

facilitate discussions within this text. The feature separating Pass Abel and Quatre Bayou Pass has been informally designated as the Barataria Headland for purposes of this research (Figure 6).

By combining the data gathered from this specific location with other regional research, the geologic history of a more extensive area can be reconstructed. When considering the entire package, the general coastwise boundaries of this study ranges from the Caminada-Moreau Headland to the meander in the modern Mississippi River near Nairn, Louisiana, a distance of approximately 50 km. The north-south envelope of this study extends from ten kilometers offshore to nine kilometers landward of the present Barataria shoreline (Figure 5).

COASTAL PROCESSES

Tides

The mean tidal range in this area is 30 cm increasing to 45 cm or decreasing to 15 cm (NOAA, 1988) depending upon the declination of the moon (Marmer, 1954). Tides are diurnal with a small semi-diurnal component (Marmer, 1954). Due to the microtidal regime (Davies, 1980) meteorologic tides commonly dominate astronomic tidal effects accounting for more than half of the daily water level fluctuation (Wax, 1978). Wind-driven tides ranging from 30 to 90 cm may occur up to 25 times per year (Boyd and Penland, 1981).

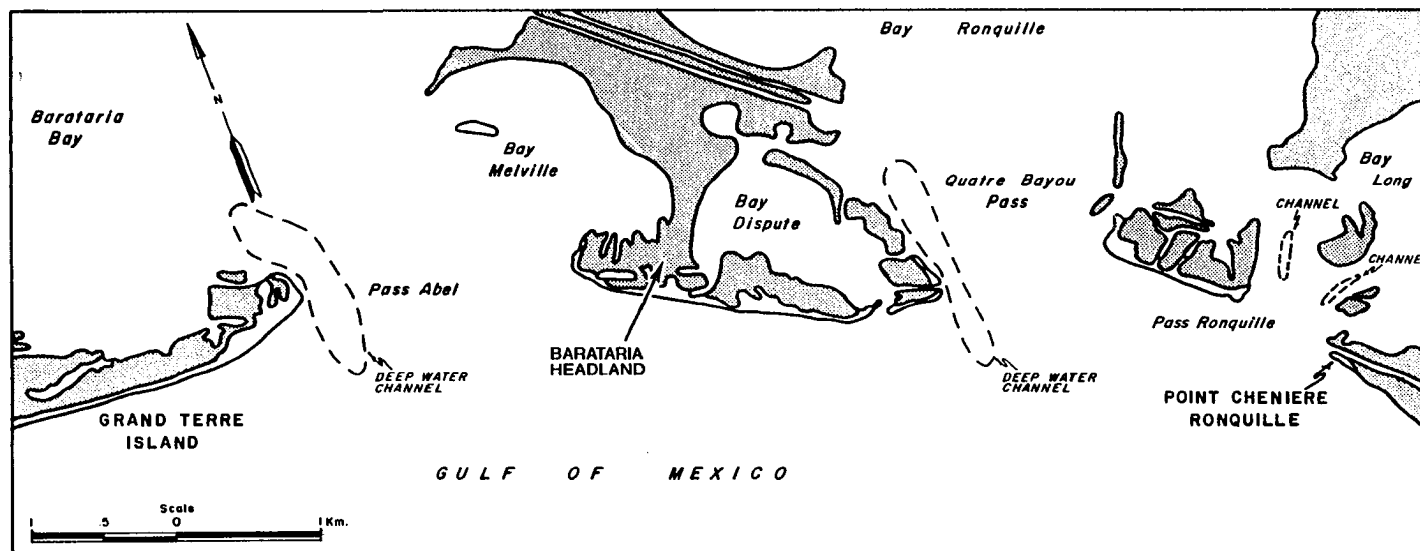


Figure 6. Location map of eastern Barataria shoreline area. Barataria Headland and Pass Ronquille are labeled as such for purposes of this research only. These names have not been formally adapted by any governmental mapping agency.

Less frequently, hurricanes and tropical storms can produce surges from 2 to 7 meters above normal astronomic tides (Boyd and Penland, 1981).

Wave Climate

A hindcast of wave data in the Gulf of Mexico determined that the average waves in the Barataria offshore area are 1.1 m high with a period of 5.7 seconds (Hubertz and Brooks, 1989). According to this hindcast, the largest sustained offshore waves experienced during twenty years of analysis from 1956 to 1975 had heights of 5.6 m. These waves occurred during Hurricane Camille in September of 1961.

Along the Barataria shoreline average daily wave heights are 0.5 m (U.S. Army corps of Engineers, 1972). Wave energies along this coastline are generally low (1.8×10^3 W/m) during non-storm conditions (Mossa et al., 1985).

Wave Approach

Twenty years of hindcast data show that nearly 90 per cent of the offshore wave energies in the offshore Barataria area are derived from the northeastern to southeastern compass direction (Hubertz and Brooks, 1989) (Figure 7). However, the extension of the modern birdfoot delta across the shelf effectively protects the Barataria shoreline from most waves approaching from any of those directions. This coastline is most exposed to waves originating from the south/southwest. Presently, dominant longshore sediment transport along the eastern Barataria shoreline is to the

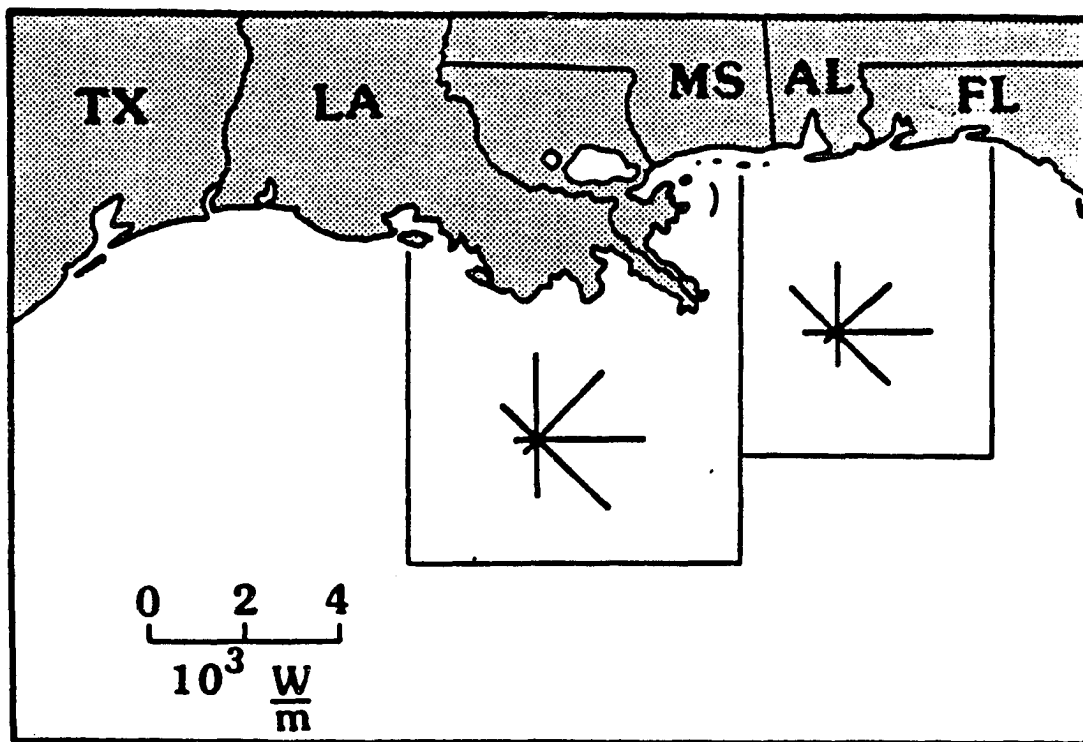


Figure 7. Wave energy diagram from Mossa et al. (1985). The dominant deepwater wave approach is from the eastern compass quadrant.

east (Nakashima, 1988).

PAST RESEARCH IN THE BARATARIA SHORELINE AREA

Literature reviews of Mississippi River delta lobe chronologies reveal a gap of stratigraphic information in the Barataria shoreline area between the Caminada/Moreau Headland and Point Chenier Ronquille (Figure 5). Welder (1959) identified two buried beach ridge plains within Chenier Ronquille (Figure 5), but could not assign their formation to specific distributary systems. Penland and Boyd (1985) described the eastern Barataria barrier shoreline as a simple flanking barrier system building westward from the Robinson Bayou headland (Figure 8).

Frazier's (1967) delta lobe chronology implies that at least three delta lobes prograded past the present Barataria shoreline (Figure 2). According to Frazier (1967) Bayou des Families was the first delta to build into this area between 3600 and 2000 YBP. Bayou Blue, a relatively short-lived delta progradation attained a maximum regression approximately 1970 YBP and overlapped the western fringe of the Bayou des Families lobe. The Mississippi River lobe, active between 900 YBP and the present, buried the eastern portions of both the Bayou Blue and Families delta lobes (Frazier, 1967). Kusters (1987) research on the stratigraphy of the upper reaches of Barataria Bay concluded that deltas were active between

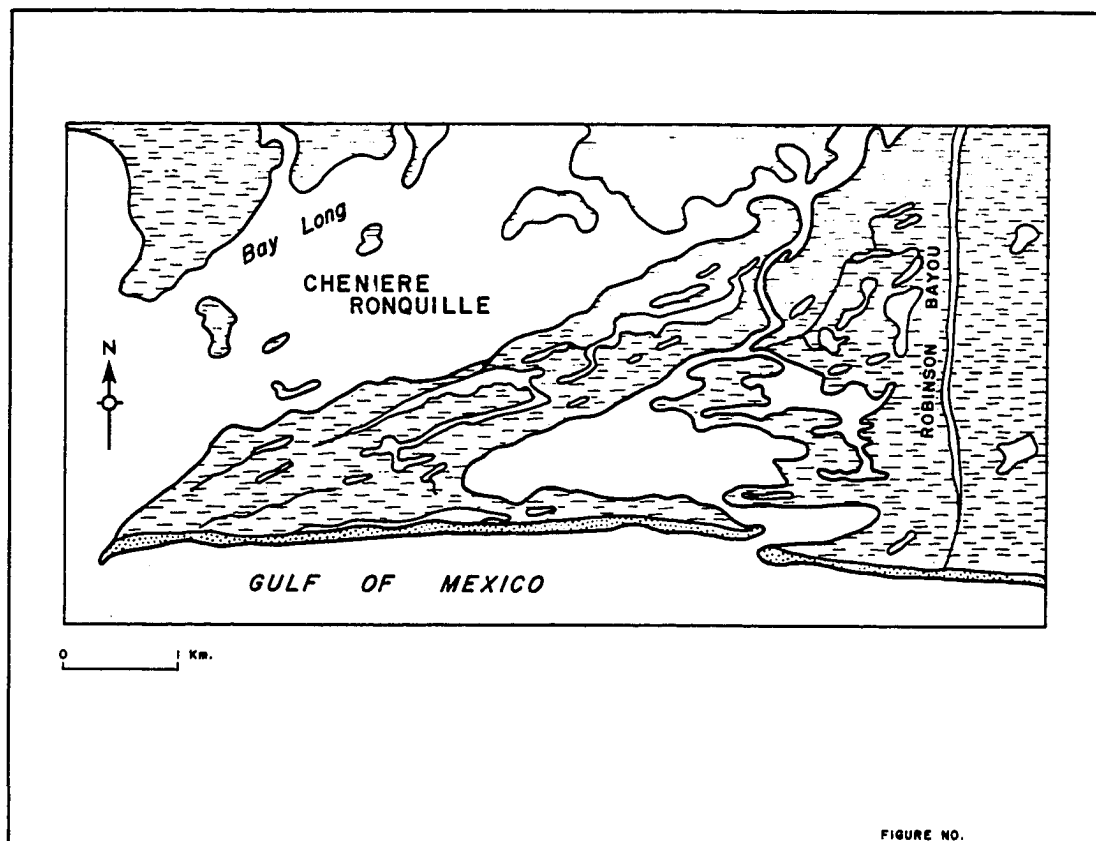


Figure 8. Penland and Boyd (1985) speculated that the Grand Terre barrier system was simply a product of headland erosion from Robinson Bayou.

2400 and 1500 YBP and then again between 600 YBP and the present. Grand Isle Barrier Island, located to the west of the study area, formed around 400 YBP and is the product of eastward sediment transport from the Late Bayou LaFourche headland system (Gerdes, 1982).

OBJECTIVES

To date, the complete depositional history of the Barataria Bight region has not been presented. Several researchers have published scenarios on all or part of the area, but none have been definitive. The first of three main research objectives is, therefore, to identify specific regressive and transgressive events that have contributed to the geologic framework of the Barataria bight area. This will be accomplished using a data base that includes vibracores, high resolution seismic data, Carbon-14 dates, and regional investigations conducted by other researchers. The refinement of the Mississippi Delta lobe chronology is of regional interest to researchers of coastal Louisiana. The second dissertation objective is of more general, worldwide significance to the geologic research community. This involves the correlation of the Barataria stratigraphic framework to phases of eustatic sea level rise and fall over the past five thousand years. The third dissertation objective is to document the processes that have accelerated the recent transgression of the Barataria

Barrier island shoreline. Tidal inlet processes have a significant impact on the destruction of abandoned delta lobes and their barrier shorelines. This research documents staged changes in tidal inlet morphology in the eastern Barataria shoreline. Tidal inlet processes, stratigraphic control and limited sediment supplies will be highlighted as the primary factors contributing to erasure of the barrier lithofacies from the current shoreface. As part of this objective the question "Why are the inlets located where they are?" will be addressed.

One of the overall dissertation objectives is to present the intricate interplay of processes occurring during the abandonment phase of the delta lobe cycle. A transgression takes different form in three different coastal zones; 1) the shoreface 2) within the tidal inlets and 3) in the bay. Bay and shoreline transgressions in Louisiana contribute to accelerated rates of coastal retreat along the delta plain. As part of this final objective, alternatives required to mitigate the rapid rate of erosion in coastal Louisiana will be addressed.

2. METHODS AND MATERIALS

HISTORICAL ANALYSIS

Maps and charts dating back to the 1700s were gathered for historic analysis of the study area. The scales on these early maps (pre 1841) were frequently too small (e.g. 1:100,000 << 1:1000) to facilitate detailed analysis of coastal change. The lack of accessibility to original or good copies of old charts required a "best effort" utilization of recopied and modified tablets found in historical archives and more recently published works. The authenticity of these sources and the degree to which cartographic license had been exercised during their reproduction could not be confidently assessed. However, they were considered reliable for documenting past morphologies of open bays and locations of past distributary channels and coastal inlets. This conclusion is based on research conducted by Historic Plans, Inc., (1984). Where at all possible, the pre-1850 maps were compared to others from similar time periods for qualitative verification and agreement of prevalent regional features. Other historical evidence was garnered from past shoreline change work done on specific reaches of this coastline by contemporary researchers such as Gerdes (1982) and Howard (1983).

Appendix I lists the maps and charts used to determine historical shoreline changes for the Barataria Barrier shoreline.

FIELD WORK

Offshore Data Set

The Louisiana Geological Survey (LGS) conducted an inventory of sand resources directly offshore of the Barataria Bight study area late in 1982. The inventory involved collection of high resolution seismic reflection data and a suite of twelve meter vibracores (Figure 9). The approximately 90 km of high resolution seismic data were acquired using a 3.5 Khz Ferranti Ocean Research Engineering (O.R.E) pinger and a 300 Joule EG&G boomer system. Loran C navigation was employed during the cruise.

The objective of the Louisiana Geological Survey seismic survey was to locate acoustic reflectors that represented potential sand borrow areas. These reflectors, identified as channels or relict barrier islands, were selected for vibracore sampling. Gross features such as distributary channels are recognizable in this data set. The data quality, however, is not good enough to determine more subtle stratigraphic relationships. Marginal seismic data quality was attributed by LGS equipment operators to poor sea and weather conditions.

A twelve meter Alpine type hydraulic vibracorer deployed from a jack-up barge took twenty-six cores within reflectors targeted from analysis of the seismic information. The cores were taken to a Baton Rouge laboratory where geologists from the Louisiana State

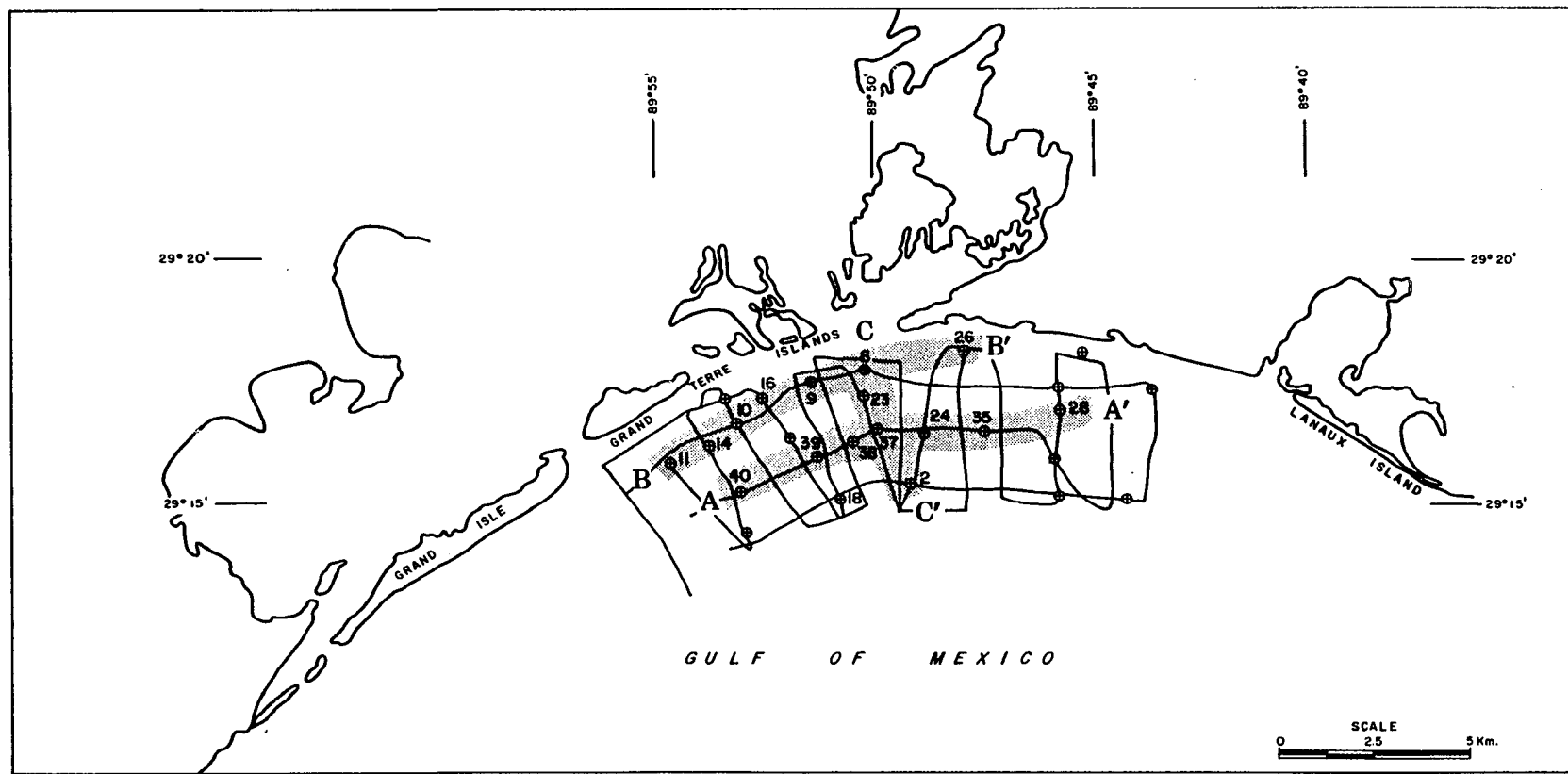


Figure 9. Location of offshore cores and seismic information used in this research. This data was collected by the Louisiana Geologic Survey in 1983. A total of Twenty-six 10 m vibracores and 90 km of high resolution seismic data was gathered.

Geological Survey Coastal Program described them.

During vibracore operations sample recovery is frequently less than the depth that the core pipe penetrates into the subsurface. In core 8, for example, sediments either compacted by 1.5 m or dropped from the 6 m core barrel during recovery. Controlled tests have never been conducted to determine whether the sample is lost, compacted, or a combination of both. It is probably a combination of the two. Where core compaction or sample loss is experienced, an error range must be factored in when determining the depth that facies occur.

The accuracy of the depth measurements and care in positioning during the coring operation has an additional impact on facies correlation. Positioning during both the seismic and vibracore cruises employed Loran-C, a navigational aid not normally used for precision survey work. It has a range accuracy of ± 30 m which translates to a significantly greater positioning error of ± 100 meters. Water depths were recorded during the coring operations using a hull mounted fathometer. These fathometers are not survey grade and are not frequently calibrated. Nominal accuracy for commercial grade, hull mounted fathometers is $\pm 5 - 8\%$ of the measured depth (Charboneaux, pers. comm.) At depths of ten meters fathometer error will be $\pm .5$ m, at 5 m depth $\pm .25$ m, and so on. The ship fathometer is most accurate in shallow

water where its primary shipboard purpose is to inform the ship operator when the bottom shoals. Ship operators are less concerned about water depth when there is no danger of running aground. Additionally, many bottom-mounted transducers measure water depth between the vessel bottom and the seafloor, not from sea level. Shipboard field notes taken on 7/27/83 questions whether the fathometer is calibrated to the bottom of the barge hull or the water surface. It is not clear whether any correction was added to the reported depth.

In addition to using a fathometer which was not "survey grade", water depths recorded during core acquisition were not tied to any datum, such as mean low water. In light of this collective information the vertical accuracy of "top of core" elevations is dependent on the depth of water from which it was retrieved. The cores taken in the deepest water are considered accurate to ± 1.0 m.

The specifications of the equipment used during a survey need to be taken into consideration when correlating the offshore cores. It is important to note that the research objectives of the Louisiana Geological Survey Offshore Sand Inventory Program and those outlined in this dissertation require data of differing resolution. The LGS program was designed simply to find and identify sand resources. These data are being used herein to assist in the development of the depositional history of the area just

offshore of the Barataria shoreline. The LGS data set is admittedly less suited for the latter task. Hence, the use of the offshore data to produce a depositional history is considered a "best effort" application of data not originally collected for that purpose.

Coastal/Onshore Data Set

Sixty-five vibracores averaging 6 meters in length/depth were taken along the coast between the east end of Grande Terre and Cheniere Ronquille during the summer of 1983. Coring was concentrated at each of three inlets: Pass Abel, Quatre Bayou Pass, and Pass Ronquille (Figure 10).

Core Acquisition

The cores were obtained using a modified concrete vibrator utilizing techniques described by Lanesky et al., (1979). The portability of this system allowed cores to be taken from a 7.5 m aluminum skiff in shallow bays. The maximum water depths that could safely be cored in was approximately 1.5 m. Land-based cores were obtained by carrying the system to the sampling site. The coring apparatus consisted of a five-and-a-half horsepower Briggs and Stratton engine which, by way of a flexible cable, transmitted mechanical vibrations to an aluminum irrigation pipe, 7 m long, 10 cm diameter with wall thicknesses of 0.15 cm. The vibrating pipe caused liquefaction of the sediments as it penetrated downward into the substrate. When the barrel was completely sunk into the ground or was

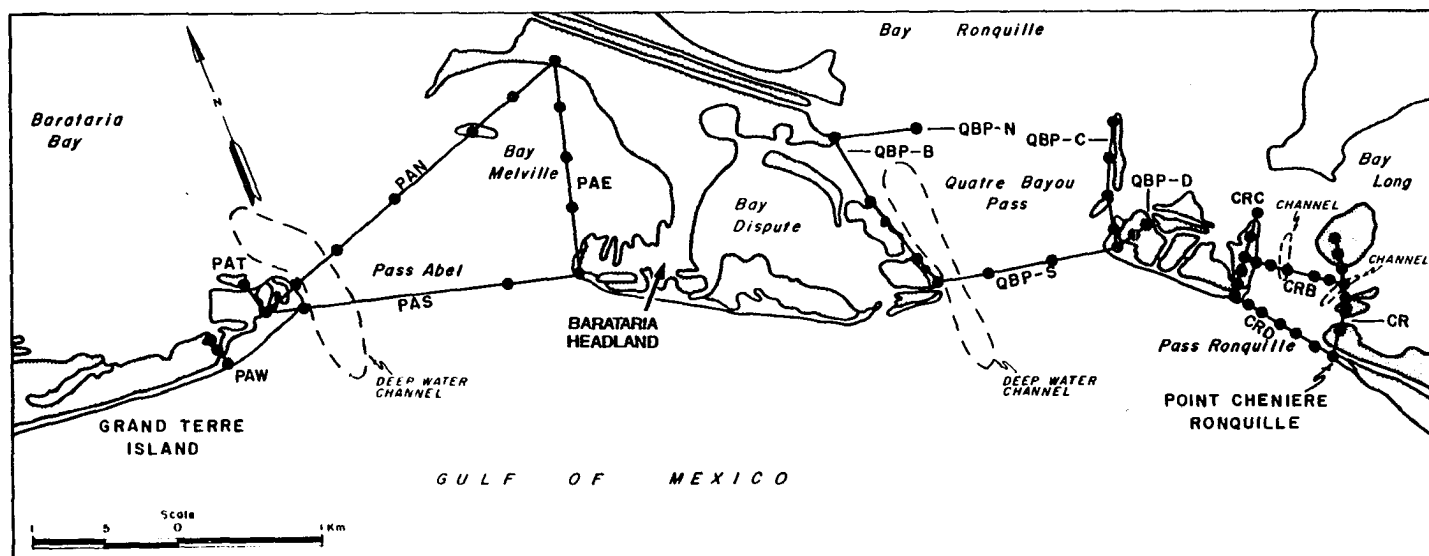


Figure 10. Core location map for onshore data set. A total of fifty-eight cores were taken with an average length of 6.0 m.

halted by impenetrable subsurface material the coring stopped.

Excess core barrel sticking out of the ground was cut off and the distance between ground surface and the sample inside the tube measured. This measurement defined compaction. The portion of the barrel above the cored surface was then filled with water and fitted with a plumber's "pipe stop" (an air tight plug). The pipe stop created a vacuum which kept the sampled material from falling out of the core barrel during removal.

Cores were extracted using an aluminum tripod set over the sample location to which either a hand-winch ("come along") or chain-hoist was attached. The chain hoist was preferred due to its safer, smoother operation. Once the core barrel had been pulled free of the ground its direction of fall was easily predicted on both land and water. On land, the core barrel would invariably tip in the direction that our faithful field dog "Willie" was sleeping. In water, it fell, as if aimed, toward the most vulnerable portion of the boat. When the core barrel had been pulled free of the ground the core barrel was gently tipped to just over horizontal, the pipe stop was removed, and the water slowly decanted. This procedure minimized sample disturbance or loss from the top of the core. The core was labeled and cut into sections that were more manageable for transport back to the laboratory. Labeling consisted of core

designation , an arrow pointing to the top of the sample and the date of acquisition. In the field notebook core length was recorded to enable emergency means of sample identification in the event labelling was rubbed off during transportation or storage.

Core Positioning

There were no monuments or benchmarks in the project area to which core locations could be properly surveyed. In addition, the straight coastline lacked clear line-of-sight between the passes. Cores were positioned using 7.5 minute, U.S.G.S. topographic maps, aerial photographs, bathymetric profiles and "un-tied" transit/stadia work. Horizontal core positioning was probably accurate to ± 10 m. The absence of vertical benchmarks in the study area required that all core elevations be estimated to mean sea level. The small tide range allowed vertical positioning of the cores to ± 0.3 m.

LABORATORY METHODS

Core Preparation

Following the field effort the cores were transported to the Louisiana State University Sedimentary Laboratory where each was cut into meter-long segments. Each segment was checked for complete and correct labeling (including an arrow pointing towards the top of the core) and marked "A" for the topmost segment, "B" for the next segment,

continuing sequentially until all of the core was labeled. The core segments were completely filled so horizontal storage could not disturb the sample.

Before a core was described all of its segments were gathered for processing. They were placed one by one in a secure wooden cradle for opening. A circular saw was set for a shallow cut and run along the top rails of the cradle. Blade contact with the actual core was minimized by cutting only the thin walls of the aluminum tubing. After longitudinal cuts were made on both sides of the tube a garotte (thin piano wire) was pulled through the core sample separating it into two halves. Half of the core remained out for description while the other half was covered by Saran wrap and sealed in a plastic sleeve for archival purposes, future sediment size analysis, x-ray radiography, and radiocarbon dating. The unsealed core half was laid open, planed to a clean surface and left to dry overnight before describing. With approximately twelve to twenty hours of air drying bedding planes and subtle changes in sedimentary features and lithology became more recognizable. Prior to commencement of destructive laboratory descriptions color and black and white photographs were taken of the whole cores and also close-ups of selected target sections.

Core Description

Each core was analyzed utilizing an hierarchal system of descriptive terms which could later be keyed to specific depositional environments. Sedimentary structure, lithology and qualifiers were used to assist in the determination of depositional sedimentary environments. Sedimentary structure described the proportion of burrows to primary sediment structure in a core unit. This technique was used to discern rates of sediment influx during deposition (Moore and Scruton, 1957). For example, regular layered units exhibited a lesser degree of bioturbation than a mottled unit and therefore probably experienced higher rates of deposition.

Lithology was described as a shell hash, sand, silt, or clay, and combinations thereof. Where percentages of varying lithologic components were observed the materials were listed in ascending order of presence. For example; sandy, silty, clay had more clay material than both silt and sand, and more silt than sand. This determination was in most cases qualitative except where mechanical coarse sediment analysis was employed. Qualifiers are terms used to describe environmentally specific parameters occurring within a depositional unit. These included primary structures, such as ripples and laminations, and other features which denote bed shear, and diagnostic fossils, i.e., burrow morphology, organic content, wood and plant

debris, and shell material. Color was found not be of particular use in describing or correlating the core samples, except in the finest clay sediments where oxidized seams were apparent. Oxidized organic material within a sandy matrix sometimes revealed ghost structures of deteriorated roots.

Coarse Sediment Analysis

One hundred and seventy seven sand samples were analyzed by sieving. Sand textures were used to test for graded beds and check lithologic correlations between adjacent cores. Each sample was sieved at half phi intervals between - 2.0 phi and + 4.0 phi. Each size fraction was weighed and its percentage determined. This information was used to determine grain size, sorting, and kurtosis (Folk, 1974). In addition, the percentage of shell and terrigenous mineral matter was also estimated. Shell fragments were identified to the species level where possible. Appendix II lists the sedimentological parameters of sands analyzed for this dissertation.

X-Ray Radiography

Clays and silts often appear homogeneous in core. X-ray radiography involves a nondestructive technique for observing structures within fine-grained sediments (Hamblin, 1962). In X-ray prints stratification, burrows, and root structures become visible allowing a much more accurate assessment of environments of deposition. Where sediments

maintain a plastic integrity the fine-grained unit to be X-rayed is cut into rectangular slabs approximately 30 cm X 10 cm X 1 cm. It is crucial to maintain consistent slab thickness to insure even exposures. The slab is placed over film and exposed to X-rays. Subtle density differences in the sample cause differential absorption of radiation. Images of the structures are imprinted as a photographic negative on the X-ray film (Roberts et al., 1976). The type of film used for this dissertation was Kodak RediPak Type M. When compared to less expensive film used for medical purposes, it was found that RediPak industrial film provided better contrast and resolution for analysis of sedimentary structure. Four hundred and twenty X-rays were made of fine grained units whose structure were largely undiscernible to the naked eye.

Radiocarbon Dating

Nine samples of rooted and shelly material were dated by carbon-14 radiocarbon dating techniques (Table 1) . In all but two cases the material selected to be dated was in-situ roots. Shell samples were removed from the core sample and scrubbed clean to remove any foreign materials. Then the surfaces were etched by in .2N HCL acid until their surfaces were "pearly". Subsequent preparation and treatment of the samples is described in Appendix III. The standard treatment of rooted material included "picking", or removing the organic material from its surrounding muds,

cleaning it thoroughly and boiling it for thirty minutes in 0.2N HCL. Appendix III describes subsequent treatment of the organics prior to measuring the radioactivity. The age was calculated using a carbon-14 half-life of 5780 years, and related to the base year of 1950 AD.

























Graphic Presentation of Core Information

Written descriptions of the core at a resolution of one centimeter were used to produce graphic logs of each core. The core information was drawn using standardized symbols to facilitate efficient recognition of similar and/or dissimilar vertical sequences and subtle lateral facies changes (Figure 11).

TABLE 1 C-14 Sample Information

SAMPLE	POSITION	LAT/LONG	DEPTH	MATERIAL	DATE YBP
CR-1	29-18' 58" LAT		1.70	ROOTS	400 +/- 50
	89-49' 43" LNG				
CR-5	29-18' 56" LAT		5.70	ROOTS	2440 +/- 100
	89-49' 43" LNG				
CRC-2	29-19' 00" LAT		2.60	ROOTS	860 +/- 60
	89-50' 00" LNG				
CRD-1	29-18' 58" LAT		1.20	ROOTS	150 +/- 60
	89-45' 21" LNG				
QB-4	29-18' 43" LAT		2.55	ROOTS	710 +/- 350
	89-51' 21" LNG				
QB-2	29-18' 41" LAT		5.00	SHELLS	3710 +/- 110
	89-52' 21" LNG				
PS-1	29-15' 00" LAT		3.40	SHELLS	3700 +/-100
	89-55' 00" LNG				
PE-2/3	29-18' 14" LAT		4.40	ROOTS	1970 +/- 60
	89-53' 12" LNG				
PW-1	29-17' 29" LAT		1.00	ROOTS	MODERN
	89-54' 27" LNG				

CORE DESCRIPTION SYMBOLS

 mean grain size	 trough cross-bedded
 fining upward	 climbing ripples
 coarsening upward	 rip-up clasts
 C-14 date	 shell disart/frag
 burrowing	 shell articulated
 erosional contact	 roots
 horizontal laminae	 wood debris
 wavy laminae	 organics
 flaser	 distortion
 lenticular	 sand
 clay drapes	 CaCO ₃ nodule
 ripple bedded	 micro-fault

FACIES ABBREVIATIONS

BF — Bayfill	BK — Backshore
DF — Delta Front	PP — Pass Platform
C — Channel	PM — Pass Margin
CA — Abandoned Channel	S — Spit
OP — Proximal Overbank	BY — Bay
OD — Distal Overbank	FTD — Flood-Tidal Delta
M — Marsh	ETD — Ebb-Tidal Delta
B — Barrier	RV — Ravinement

Figure 11. Key to symbols used to denote the characteristics of the cores. The alpha abbreviations designate facies types interpreted from the core characteristics.

3. FACIES DESCRIPTION, CHARACTERIZATION AND INTERPRETATION

The stratigraphic record of the Barataria area (+1.0 m to -21.0 m MSL) contains a wide range of depositional systems (or lithofacies). The surficial morphology is presently dominated by shallow bays, delta plain marsh, and barrier/tidal inlet complexes. The inlets (herein called passes) are wide and shallow, except on the west side where deep, narrow channel thalwegs are located in Pass Abel and Quatre Bayou Pass. The subsurface geology is dominated by facies of past delta lobe progradations, i.e. channel, overbank, bayfill, and delta front deposits, and others.

The following chapter is separated into two parts. In part 1, subsurface facies are characterized by lithology, primary bedding, burrowing and organic and shelly content. Next, the facies is described in terms of the processes that contributed to its deposition. For example; ripple-bedded sands suggests that stronger currents are present than a heavily rooted facies. The combined lithofacies and inferred processes allow a specific depositional environment to be assigned to the facies (i.e. bayfill, delta front, active or abandoned channel, etc.). This interpretation is compared to similar facies identified by other researchers in analogous depositional settings.

In the second part of this chapter the cored environment is seen on the surface and is already known. In this instance, the parameters described in the top portion

of the core from the known depositional setting can be used to identify similar occurring facies in the subsurface. Table 2 lists the facies that were interpreted from the core data and the criteria used to characterize them.

PART I - SUBSURFACE FACIES INTERPRETATION

Lithofacies Bayfill (BF)

Description: Lithofacies BF consists primarily of alternating clays and silts with a small percentage of interbedded sand (Figure 12). It is commonly dark in color, appearing homogeneous to the eye. X-ray radiography, however, reveals distinct laminations (Figure 13). These laminated intervals are interbedded with burrowed ones in some cores (Figure 14). The laminated units rarely include shells or organics that are sometimes observed in the burrowed interval. Rooting is infrequently observed. It is seen in x-ray radiographs as vertical white filaments (Figure 14). Thin (<2 cm) graded beds with woody detritus and shell fragments are also found in this facies (Figure 13; core PAT-3). Primary structures in this facies includes ripples and soft sediment deformation (Figure 13). Wavy, and lenticular bedding with isolated silt lenses were noted within this facies.

This lithofacies is commonly part of an overall coarsening upward sequence. It may lie above or below

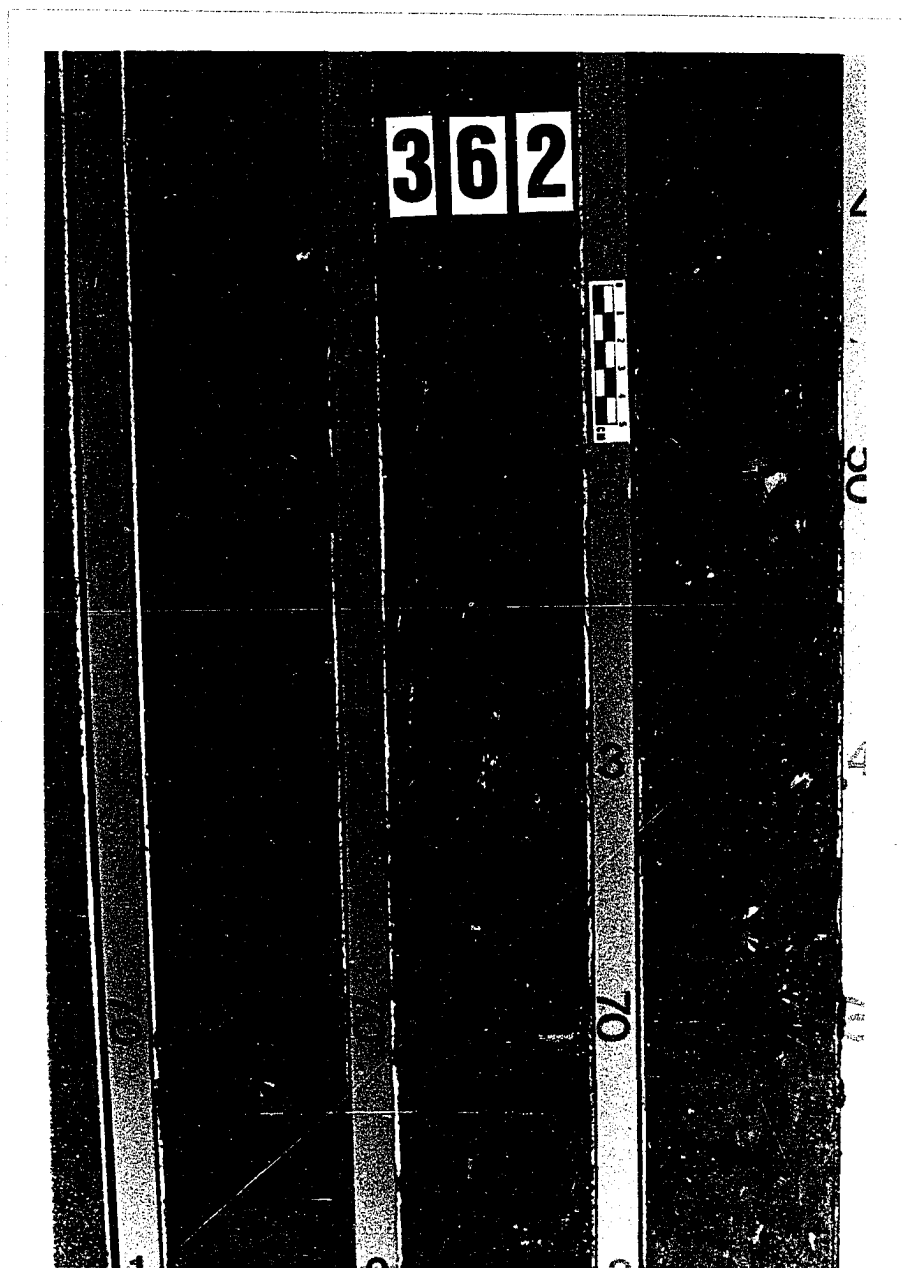


Figure 12. Photograph of BF (Bayfill) facies in core QBP-S-2. Noteworthy are the single round, sand filled burrow at interval 250 cm and the silt laminae within the clay matrix.

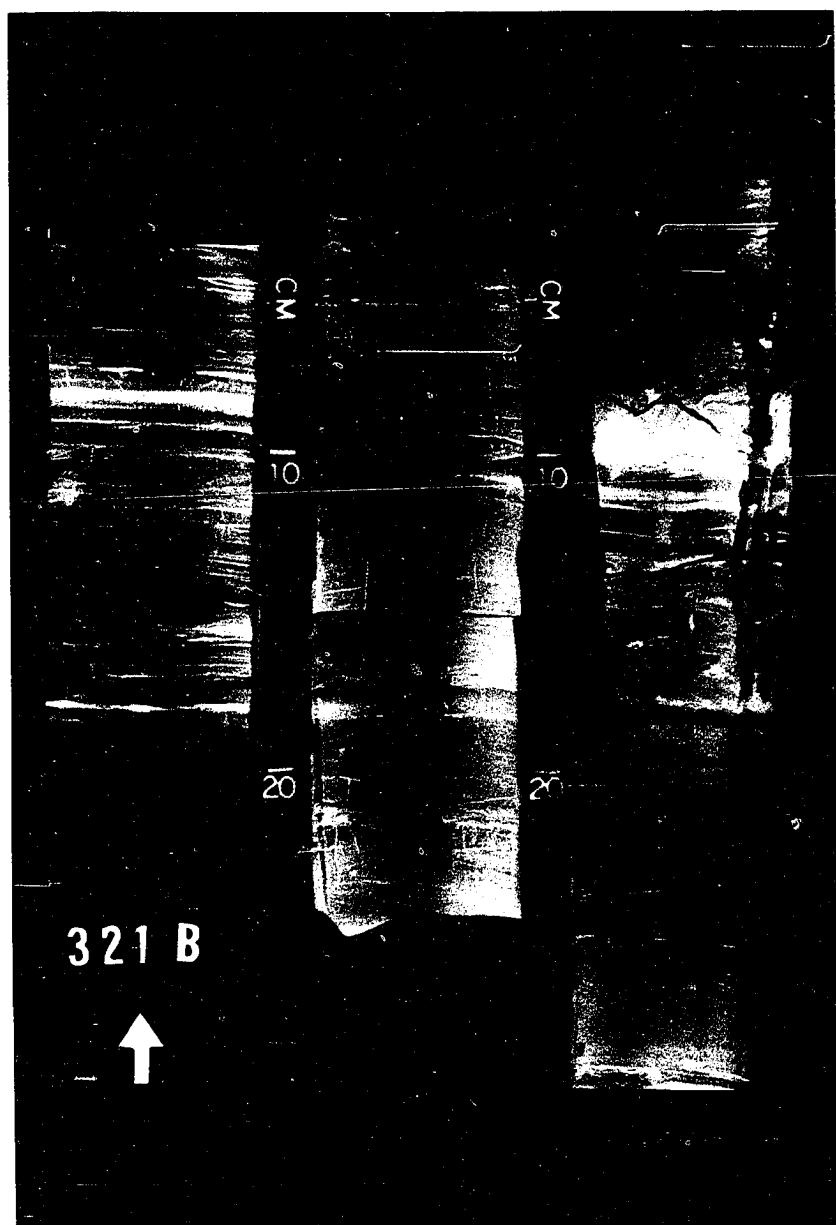


Figure 13. X-ray radiograph of clay dominated BF, bayfill facies, QBP-B-1. Ripples superimposed on ripples are evident in the middle column just above the 10 cm interval.

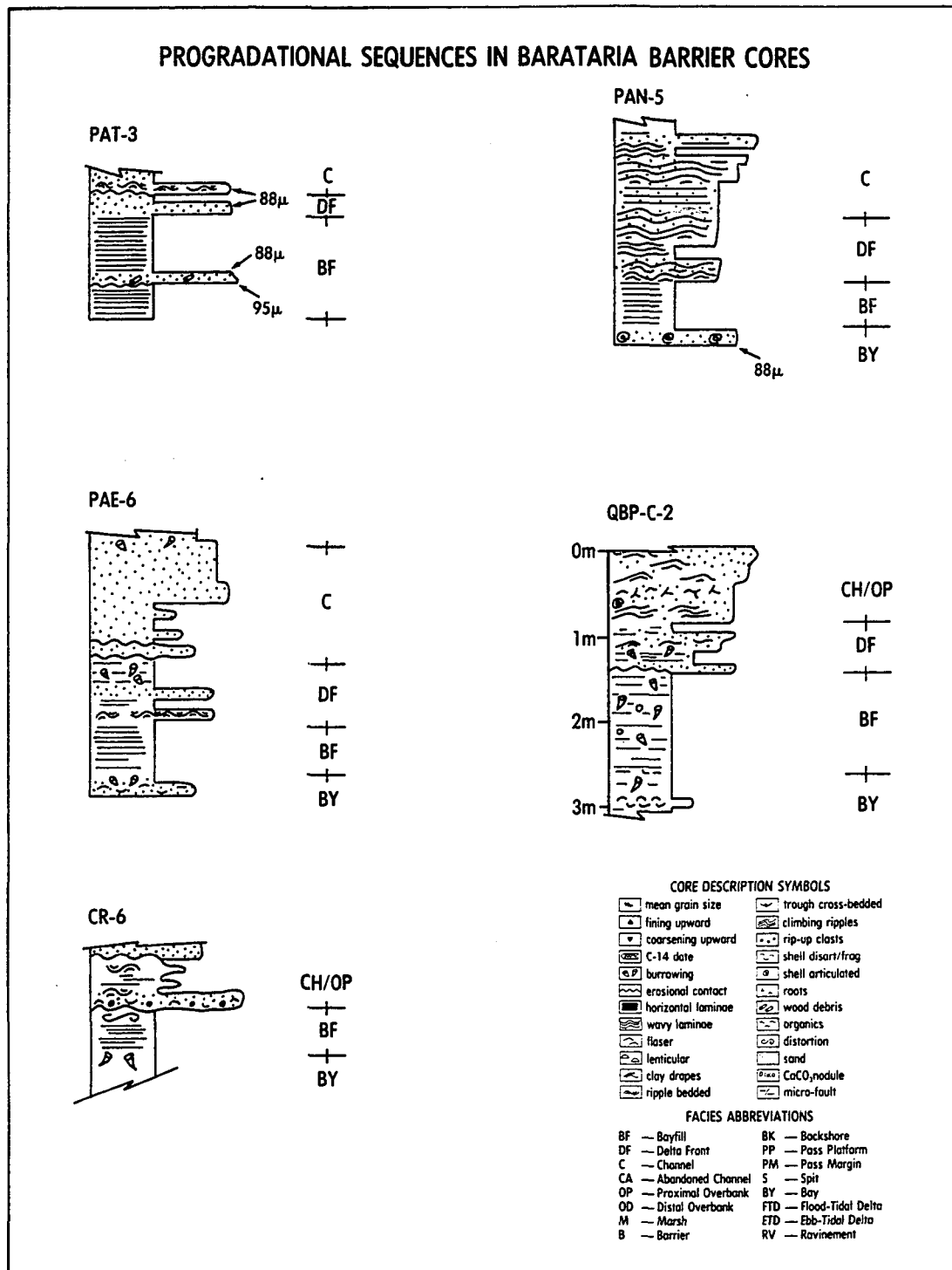


Figure 14. Diagrams of sequences that include bayfill units in the Barataria cores. Note the predominance of burrowed bay clays at the base and the variety of erosional and rapid gradational contacts above the bayfill facies.

burrowed, shelly muds with a gradational contact.

Frequently, BF is overlain by coarser lithologies, such as wavy bedded silty sands and sands of the delta front (DF) facies. The upper contact may be either erosional or conformable. The overall thickness of lithofacies BF ranges from approximately 50 to 100 cm, with an average of 60 cm.

Processes: Alternating burrowed and laminated units are caused by episodic sedimentation. The lack of burrowing in the laminated unit suggests a high rate of sedimentation, presumably deposited from suspension. The burrowed intervals represent periods of decreased sediment influx. Thin layers of coarser material observed intercalated with the other intervals indicates episodic increases in bed shear stress. Rangia cuneata are the dominant mollusk species found in the thin sandy units of BF. Rangia cuneata are found in environments with a seasonal range of salinity between 2 and 18 ppt (Tarver, 1972) hence the environment of deposition alternates between freshwater and brackish. Rooting in this facies would (presumably) be established during periodic drops in water level that causes subaerial emergence. According to Salinas et al. (1986) Louisiana wetland vegetation is not flood or salt tolerant suggesting that the subaerial exposure occurred for significant periods of time.

Facies BF commonly lies above burrowed shelly muds that

FACIES	CHARACTERISTICS	THICKNESS (4.4g) cm		Nm Rv	Nm Rv	approx	SAND LAMINAE 1cm	CLAY LAMINAE 1cm	ORGANIC DETRITUS	ROOTING	SHELLS in-Situ	SHELL FRAGMENTS (F) VALVES (V)	BURROWING	BEDDED THEN BURROWED	ALTERNATING BEDDED & BURROWED	REGULAR LAYERED NO BURROWS	RIPPLE BEDDED	CLIMBING RIPPLES	X TROUGH BEDDING	PARALLEL LAMINATIONS	WAVY LAMINATIONS	FOSSIL TYPES RANGIA CUNEATA	MULINIA SP	CRASSOSTREA SP	OTHERS	UNDERLYING	OVERLYING
1 BAY FILL	60	100/50	Rv	Nm	10/90	R	C	R	R	R-C	R-C	R	R	R	C	R	R	Ø	Ø	C	C	R-C	R-C	R	R	9 14	2 3 8
2 DELTA FRONT	90	250/25	Rv	Nm	60/40	C	C	C	Ø	Ø	R	R	R	R	C	C	C	C	R	C	C	Ø	Ø	Ø	Ø	1 4 6	3 7 8
3 ACTIVE CHANNEL	130	350/50	Nm	Rv	100/0	C	Ø	R	Ø	Ø	R	Ø	Ø	Ø	C	C	C	C	C	R	R	Ø	Ø	Ø	Ø	1 2 5	4 5
4 MID AB CHANNEL	"	350/50	Nm	Nm	60/40	C	C	C	R	Ø	R	R	Ø	R	C	C	C	R	R	C	C	R	R	Ø	Ø	3 5 9	5 8 9
5 UPR AB CHANNEL	"	350/50	Nm	Nm	10/90	R	C	C	C	C	C	C	R	Ø	Ø	Ø	Ø	Ø	Ø	R	R	R-C	R-C	Ø	Ø	4 8 1	8 9 1
6 PROXIMAL OVERBANK	110	350/25	Nm	Nm	90/10	C	C	C	R	Ø	R	C	C	C	C	R	C	R	Ø	C	C	R	R	R	Ø	9 8 9	7 8 9
7 DISTAL OVERBANK	"	350/25	Nm	Nm	40/60	R	C	C	C	R	R	C	C	C	R	R	R	Ø	Ø	C	C	R	R	R	Ø	6 8 9	6 9
8 MARSH	90	200/25	Ø	Ø	10/90	R	Ø	C	C	R	C	C	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	R	R	1 5 11	6 7 9
9 BAY	100	300/25	Ø	Ø	30/70	R	C	R	Ø	C	C	C	R	Ø	Ø	R	Ø	Ø	R	R	C	C	C	C	8 5 13	1 3 13	
10 BARRIER	40	175/25	Rv	Nm	100/0	C	Ø	R	R	R	C	C	C	C	Ø	Ø	Ø	Ø	Ø	C	Ø	C	C	C	C	8 9 11	1 11
11 BACKBARRIER	100	125/25	Nm	Rv	80/20	C	R	C	C	R	C	C	C	C	C	Ø	R	Ø	Ø	Ø	Ø	C	C	C	C	8 9 10	10
12 SPITS	90	350/70	Rv	Ø	100/0	Ø	Ø	R	R	Ø	R-C	C	C	C	R	Ø	C	Ø	Ø	C	Ø	C	C	C	C	8 9 10	1 9
13 FLOOD TIDAL DELTA	60	100/30	Rv	Ø	100/0	Ø	Ø	Ø	Ø	Ø	C	C	Ø	Ø	Ø	Ø	C	Ø	Ø	Ø	Ø	C	C	C	C	9 14 1	1
14 PASS PLATFORM	70	200/40	Rv	Ø	100/0	C	Ø	Ø	Ø	R	C	C	C	C	R	Ø	C	Ø	Ø	C	Ø	R	R	C	C	9 13 1	1
15 PASS MARGIN	110	150/30	Rv	Nm	90/10	C	C	C	C	R	C	C	C	C	Ø	Ø	R	R	Ø	Ø	Ø	C	C	C	C	1 8 6	1 6

Table 2. FACIES CHARACTERISTICS IN BARATARIA SHORELINE REGION

contain organics. Characteristics of this lower facies suggests lower sedimentation rates. In contrast, the lithofacies that lie above facies BF are bedded with considerably coarser lithologies, indicative of storm or flood events capable of producing higher bed shear stress. In fact, soft sediment deformation in a facies 1 unit in core CR-6 may have been induced by shear resulting from flow in overlying units (Figure 14).

Interpretation: Facies BF is interpreted to be bayfill (Table 2). Bayfill is analogous to the prodelta environment and consists of finer sediments, deposited from suspension, that precede the outbuilding of the delta front and distributary channel (Figure 15) (Coleman and Wright, 1975). Characteristics of lithofacies BF are consistent with deep prodelta (except for roots and ephemeral emergence) and shallow water bayfill environments described along the Mississippi delta plain by others. (Kolb and Van Lopik, 1958; Wright and Coleman, 1972; Coleman and Prior, 1980).

Alternating laminated silty/clay and burrowed intervals have been described in the Colorado River delta of Texas where bayfill sediments interfinger with interdistributary bays (Kanes, 1970). The occurrence of thin turbidites within the Barataria bayfill facies are similar to those observed in the Guadalupe Delta by Donaldson et al. (1970).

The newly formed Atchafalaya River delta lobe has a reported bayfill thickness of 1 to 2 m (van Heerden, 1982)

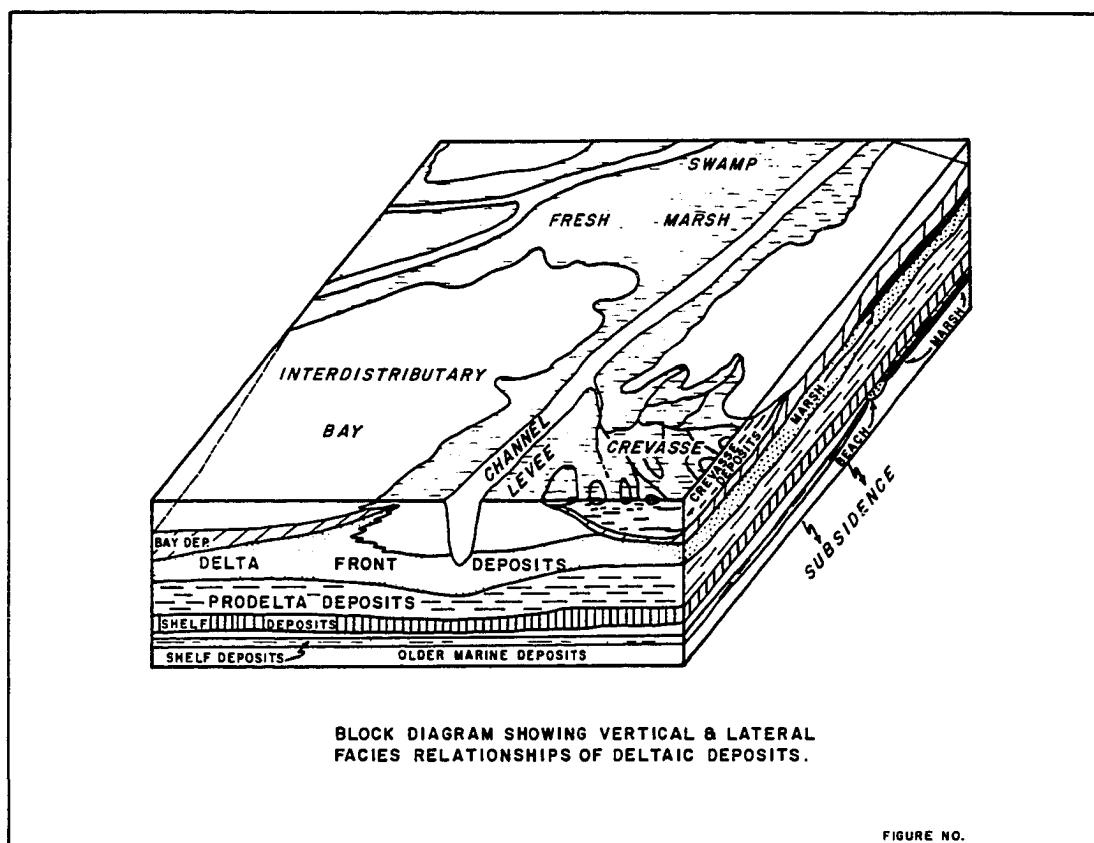


Figure 15. Channel mouth depositional environments (Modified from Gould, 1970).

Interpreted bayfill units in the Barataria cores are of comparable thicknesses averaging 60 cm. The thin nature of the bayfill units and the presence of rooted horizons described in the Barataria cores suggests that they are actually foundations of crevasse splays prograding into shallow interdistributary embayments. These should be differentiated from the massive prodelta facies described beneath the Mississippi birdfoot delta.

Lithofacies Delta Front (DF)

Description: Lithofacies DF is predominantly well stratified fine to very fine sands and silts. Overall it is part of a coarsening upward sequence with thin (<10 cm) upward fining sequences incorporated within it (Figure 16; except core QBP-B-3). These sub-units are comprised of rippled sands that grade to laminated clays with lenticular bedding (Figure 16, core CRB-2). Primary structure observed in DF includes trough cross-bedding, small ripple-bedding, and climbing ripples (Figure 17; core QBP-C-2). Higher in the unit trough-cross bedding was the most abundant sedimentary structure. Bed distortion not caused by the vibracoring, though rare, was also noted in some DF lithofacies.

Bedded intervals which are subsequently burrowed sometimes alternate with non-burrowed intervals; for example, cores CRB-2 (Figure 16) and QBP-C-2 (Figure 18). Centimeter-thick seams of wood and fine plant debris are

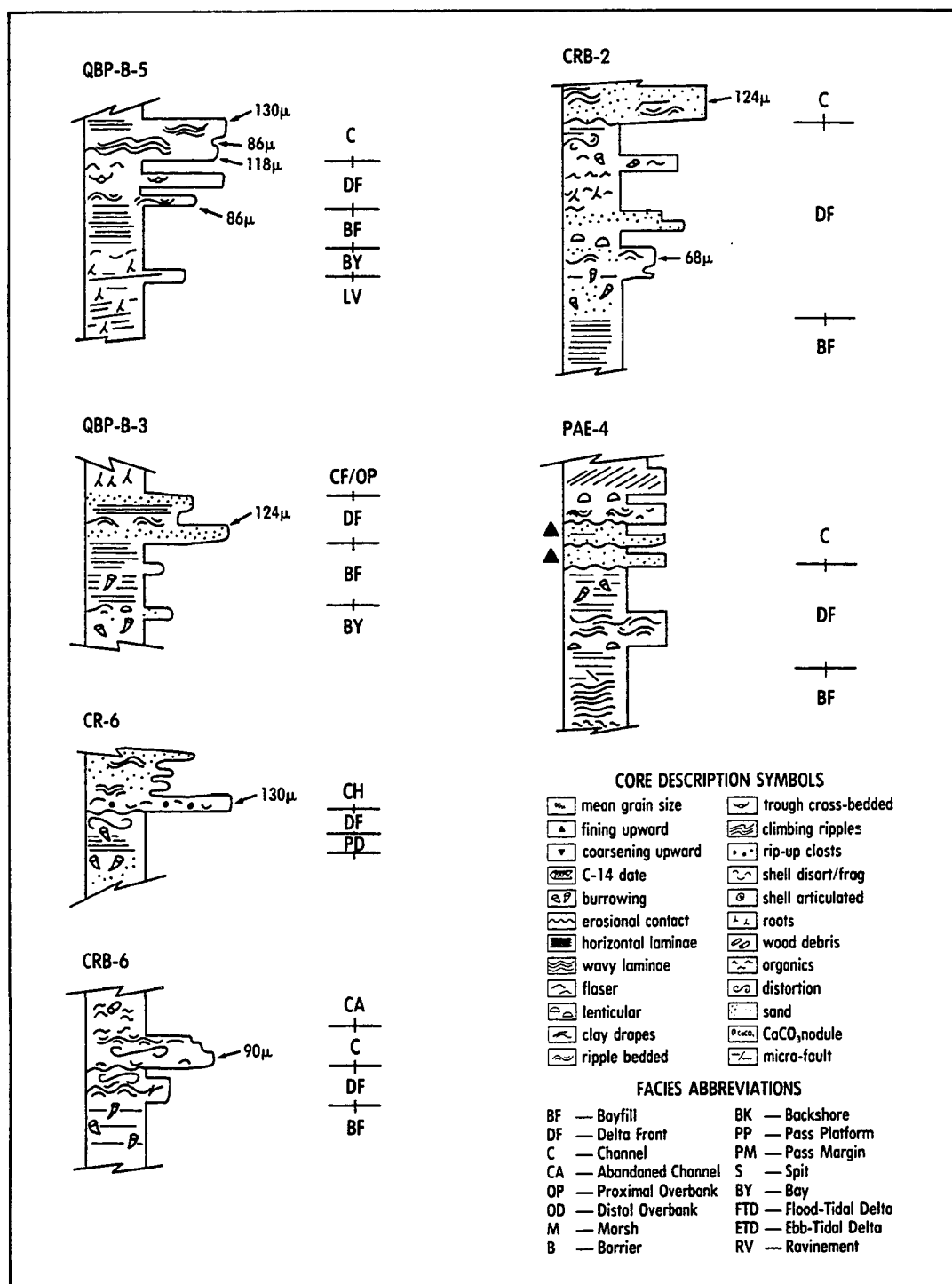


Figure 16. Diagrams of delta front sequences described in core. A variety of lithologic, bedding, faunal and organic features were seen within this component of the delta lobe.

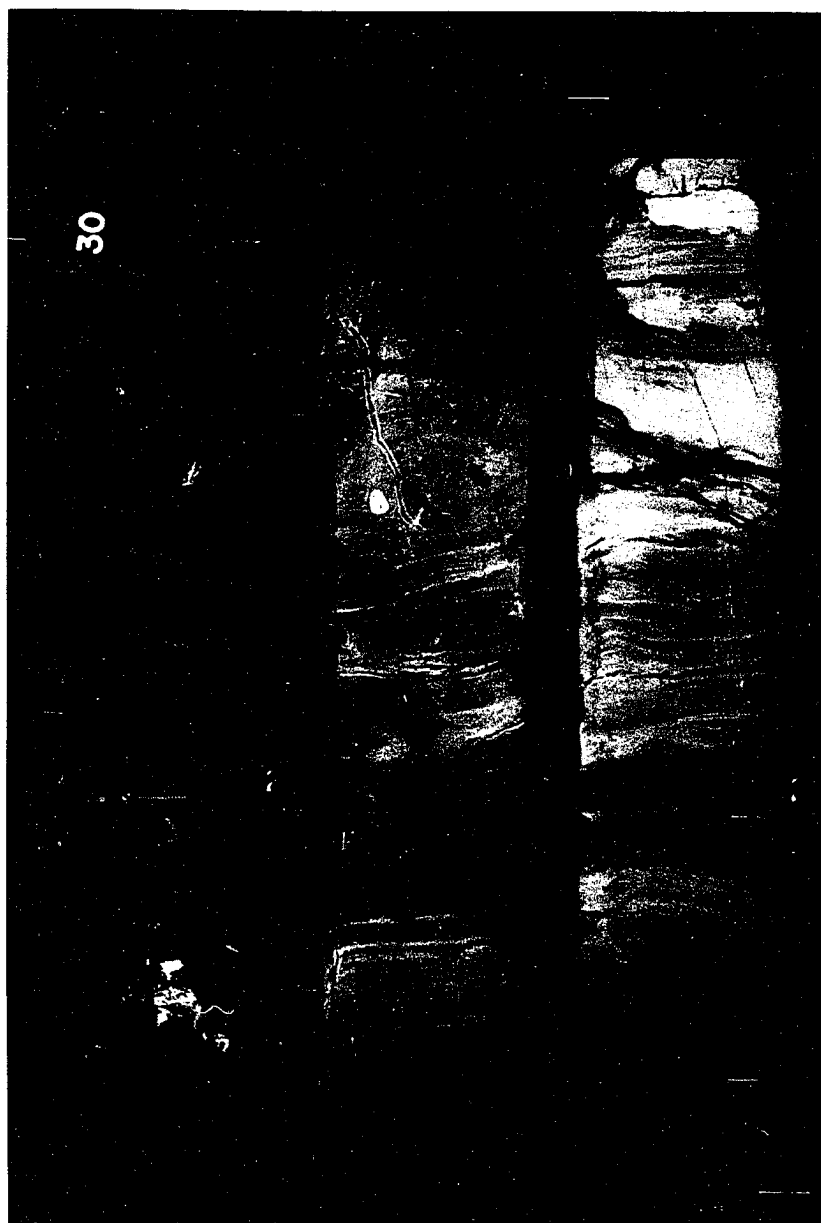


Figure 17. X-Ray Radiograph of QBP-C-2. The right column contains examples of trough-cross bedding and ripple-bedding described in Baratania core delta front lithofacies.



Figure 18. X-Ray Radiograph QBP-C-2. The bedded sequence has been burrowed extensively. The burrowing indicates decreased sedimentation rates interpreted as occurring at the flanks of the prograding delta lobe.

interbedded with the primary sedimentary structures (Figure 19) while shells are not. Roots sometimes pierce facies DF where it lies beneath delta plain marsh (Figure 20).

The average thickness of this facies in the Barataria cores is 90 cm with maxima and minima of 250 cm and 25 cm, respectively. Without exception this lithofacies overlies bayfill. The upper contact is predominantly erosional or sharp and conformable to coarser, bedded sands. In some instances DF grades into delta plain marsh.

Processes: The increased abundance in physical structure and coarser lithology indicates that significant bed shear stress was in evidence during this facies construction. The fining sequences commonly integrated within the overall upward coarsening sequence are the result of periodic changes in either water depth, flow velocity, or both. Repeated graded units within the vertical sequence were fairly common in DF facies. The noted decrease in primary sedimentary structure variability higher in the unit is indicative of less variability in sedimentation and/or shallower water.

Intervals of burrowing within the bedded units are indicative of episodic sedimentation. Slumping that occurs in this lithofacies suggests that it lies at the banks of a nearby channel. Seams of wood and fine plant debris deposited within the bedded intervals are probably plucked

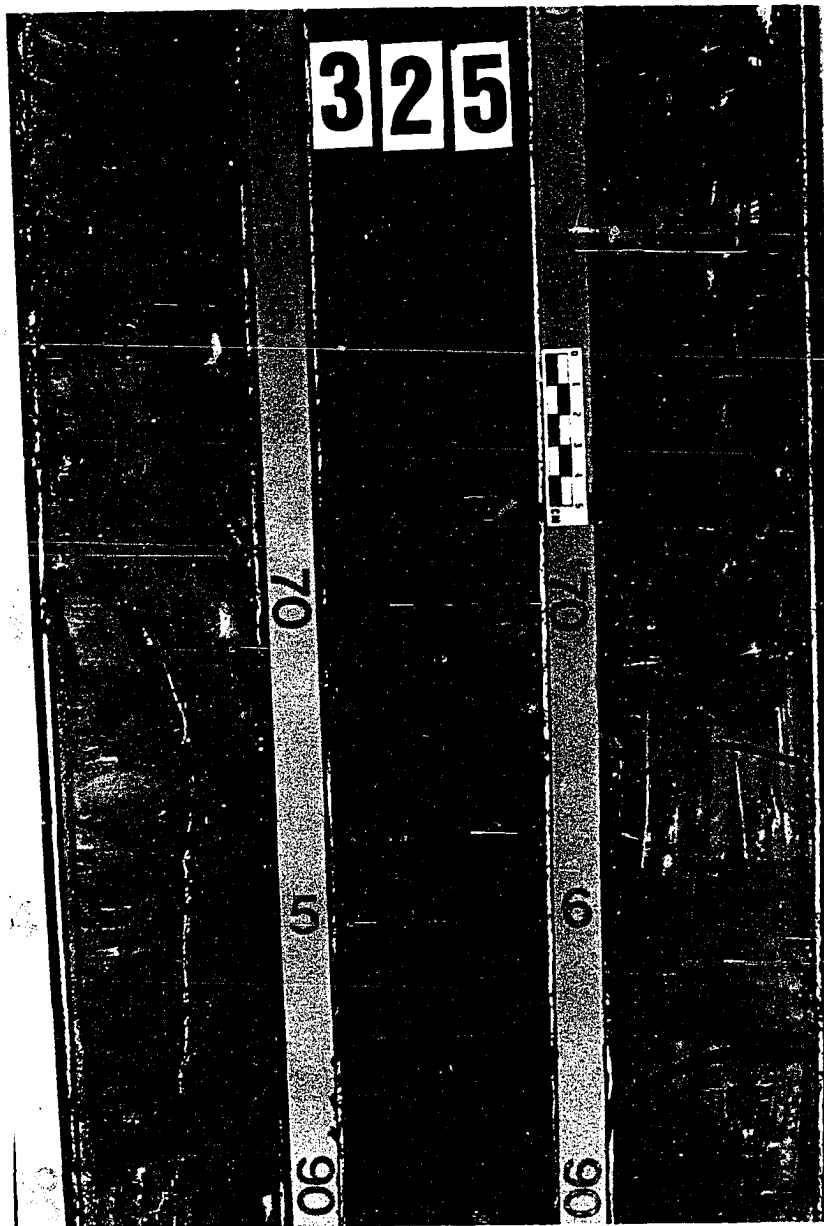


Figure 19. Core photograph QBP-B-5. Interval 590 cm to 540 cm illustrates coarsening upward delta front facies with seams of organic detritus.

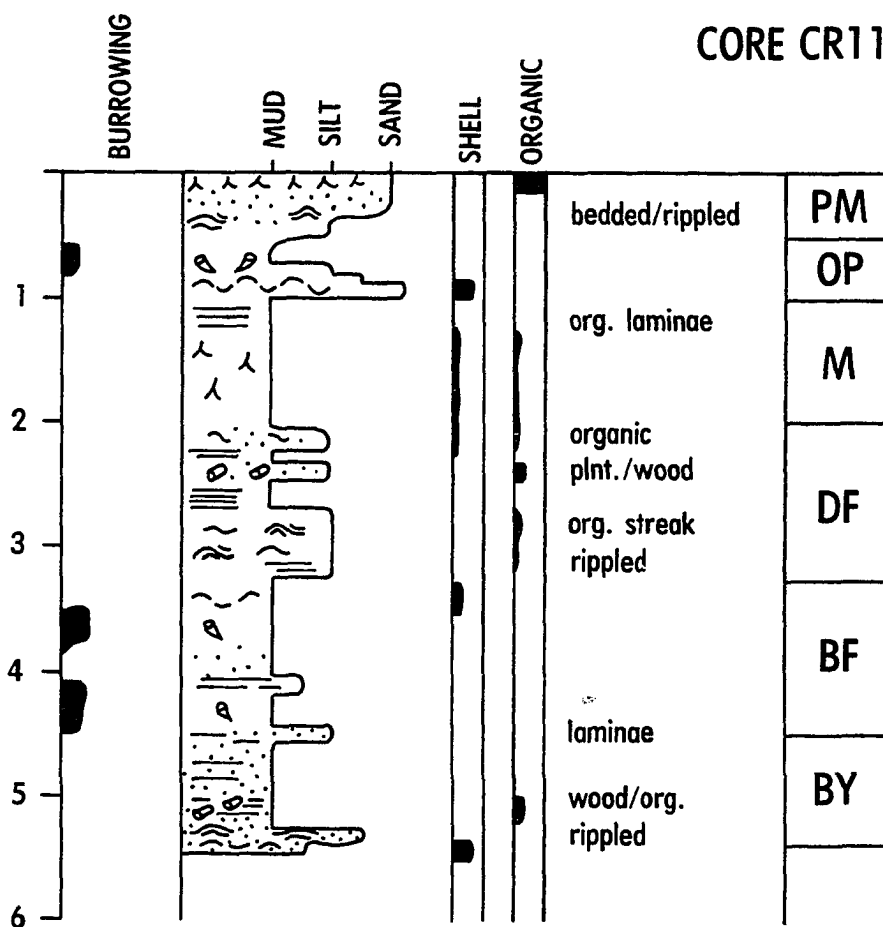


Figure 20. Core log CR-11. This thick delta front sequence was unaffected by adjacent channel deposits and is capped by marsh and bay environments.

from upstream channel banks or floated from flooded delta plain marsh or swamp environments.

Interpretation: The delta front environment best fits the characteristics described in this lithofacies (Table 2). In the classic deltaic depositional sequence the prodelta (or bayfill) coarsens slightly to delta front and then to channel facies (Wright, 1985). Delta front units of the Mississippi delta plain are comprised of fine to very fine sands and silts that are predominantly regularly layered (Gould 1970; Coleman and Prior, 1980; Van Heerden, 1982; Wright, 1985). Parallel and lenticular laminations are common throughout the delta front (McEwen, 1969; Gould, 1970; Kanes, 1970). A spectrum of ripple types occur in the lower to middle part of this facies while small-scale cross-laminae are more common in the upper portions (Gould, 1970; Kanes, 1970, Wright, 1985).

The delta front sediments fine distally and laterally from the issuing distributary (McEwen, 1969; Allen, 1970). Kanes (1970) and Donaldson et al. (1970) showed that the flanks of the delta front environment can be extensively burrowed. Burrowing occurs where sedimentation rates are low (McEwen, 1969). Slumping is also described in these facies where the unit lies close to an active channel facies. The delta front facies commonly contain seams of organics including wood pieces (Kanes, 1970; Erxleben, 1975), and fine plant debris (Laury, 1968 and Allen, 1970).

Roots may extend downward from overlying lithofacies (Laury, 1968; Erxleben, 1975).

Thicknesses of delta front units measured in major river distributary systems range between 6 and 50 meters (Erxleben, 1975; Wright, 1978). In Van Heerden's (1982) work on the Atchafalaya River, a newer lobe of the Mississippi River delta system, average delta front units were 30 centimeter thick. The smaller dimensions are more in line with Barataria delta front units that were, on average, 90 cm thick.

Lithofacies Channel (CH)

Description: Herein this facies has been partitioned into three sub-facies differentiated by position within the overall unit. The base of the channel lithofacies is the coarsest of the overall CH lithofacies. The base grades to a middle unit which is comprised of finer sands and silts with attributes similar to proximal overbank deposits. The uppermost of the CH facies is commonly homogeneous, burrowed organic clays. Overall CH is an upward fining sequence.

Core log PAE-5 (Figure 21) and a photograph of QBP-C-2 (Figure 22) illustrate the three CH sub-facies. Figure 23 illustrates the variety of CH units occurring in the Barataria cores. Channel lithofacies in the Barataria cores range in thickness from 50 to 350 cm with an average of 130 cm.

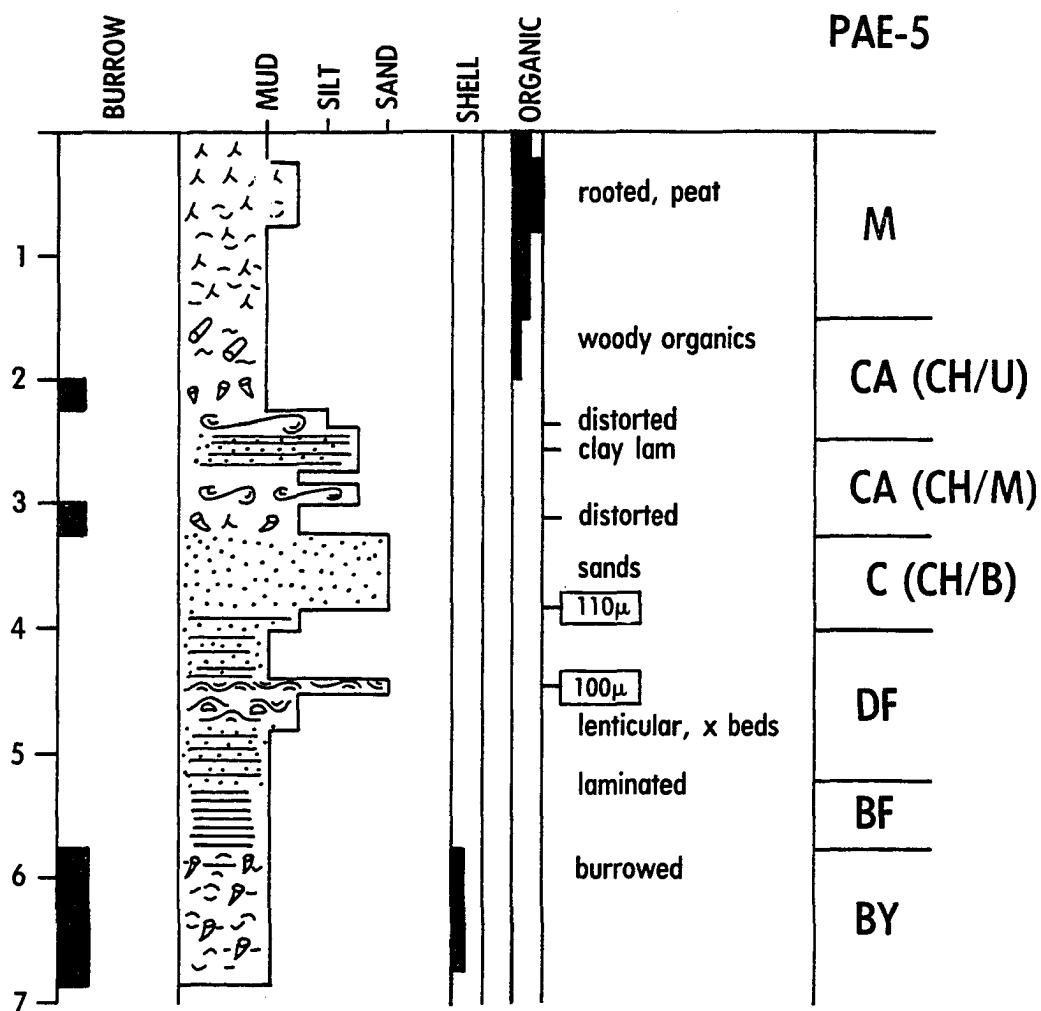


Figure 21. Log Core PAE-5. An active channel sequence begins at 5.8 m and is abandoned at 3.2 m. The abandoned channel fill above core interval 3.2 grades to marsh.

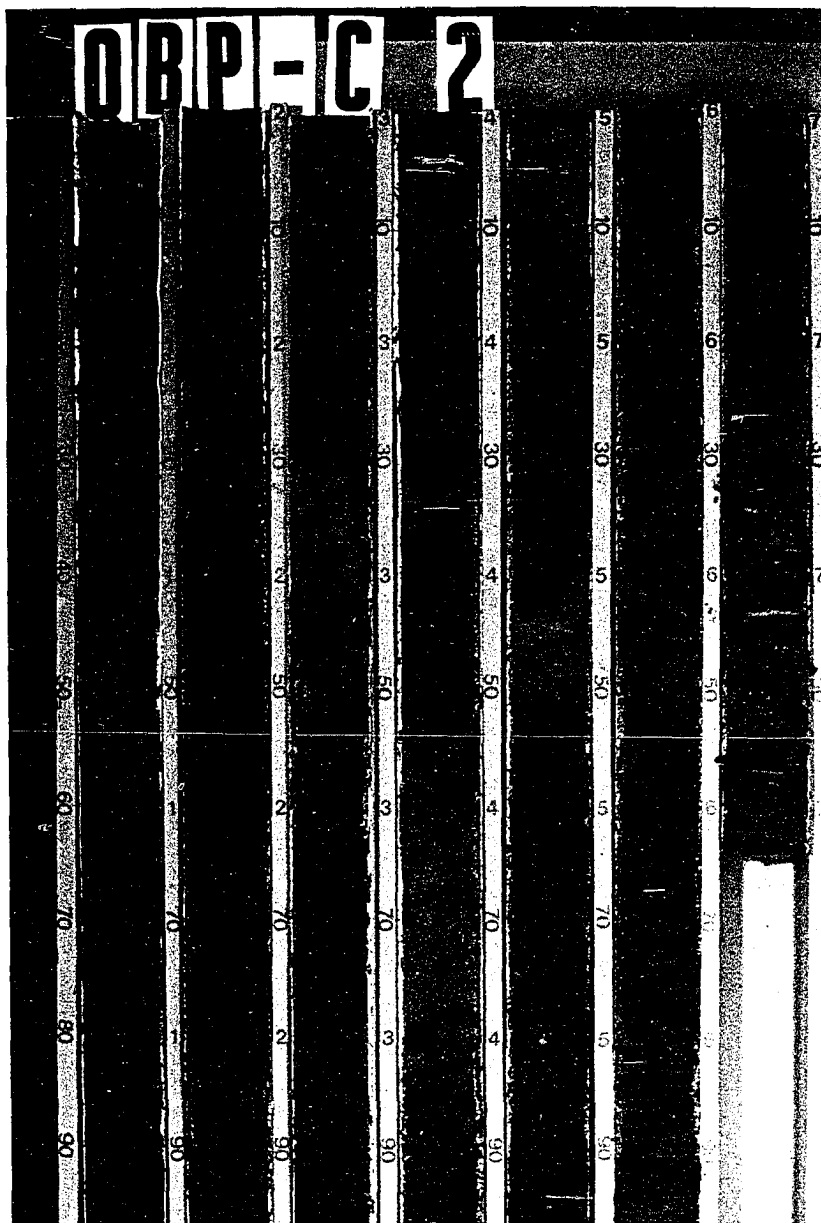


Figure 22. Photograph Core QBP-C-2. Interval 380 cm to 230 cm contains an exemplary sequence of the three channel sub-units; Active, lower abandoned and upper abandoned.

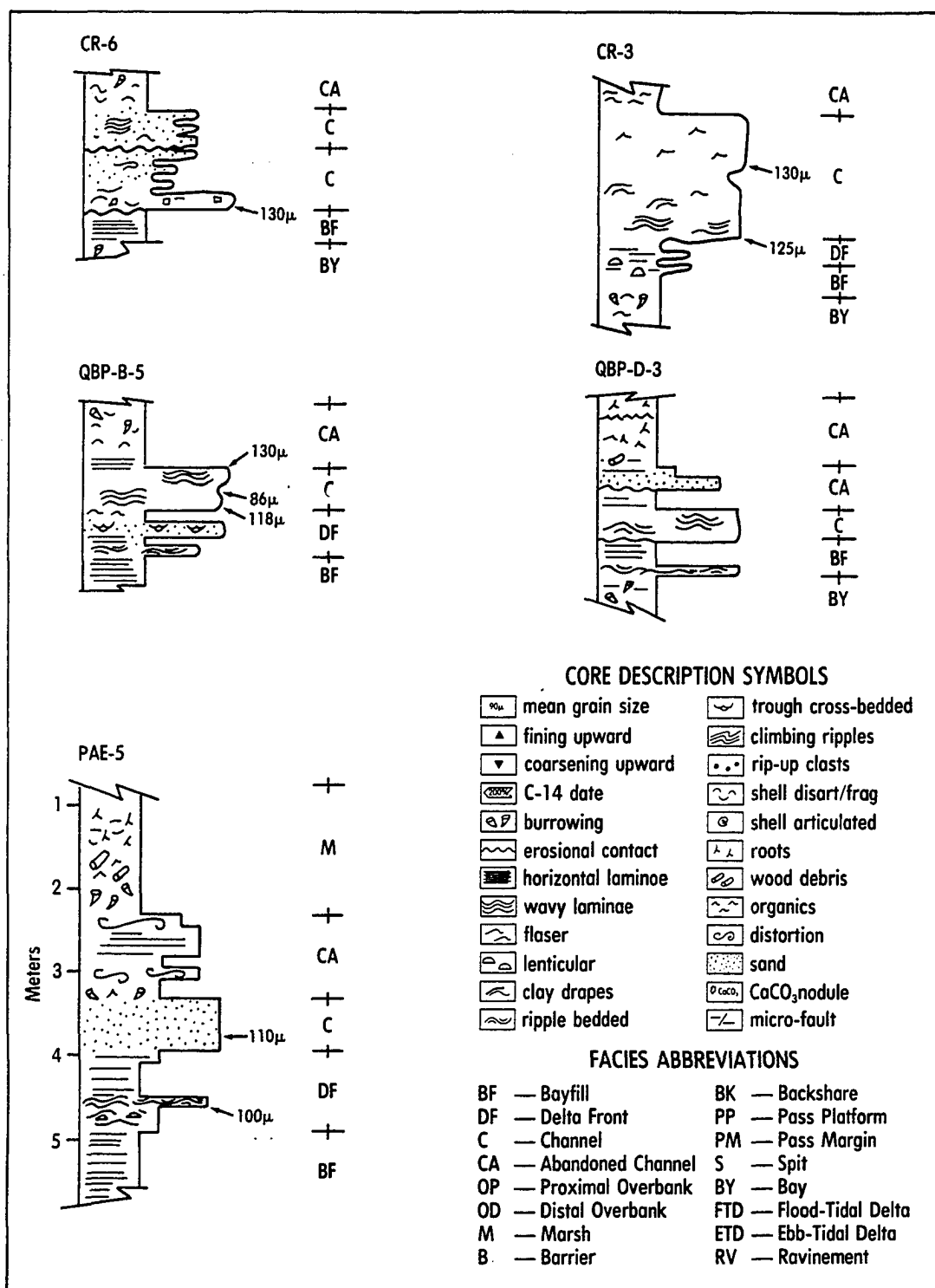


Figure 23. Diagrams of channel and channel fill sequences described in core. Note the variety of basal contact from sharp erosional (CR-6) to gradational (PAE-5). Channel fills are normally organic rich.

Sub-Facies CH-B: The basal unit of Lithofacies CH is frequently comprised of immature sands. Its gray color is the result of high heavy mineral content, i.e. ilmenite and magnetite. Selected segments of core QBP-B-1 illustrate sub-facies CH/B (Figure 24). The basal contact (of CH-B) is sharp and erosional or conformable. It most commonly overlies delta front lithofacies. Marine fauna is absent from the CH/B facies. Mud clasts are sometimes present. CH/B facies often appear homogenous in core because the sands are well sorted. Primary sedimentary structures that were observed in CH/B include ripples, climbing ripples, and small scale trough cross-stratification. The mean grain size of sands within this sub-facies is 150 μ .

Sub-Facies CH/M: The middle part of the CH lithofacies is characterized by a "melange" of interbedded finer sands (90 - 150 μ) and silts exhibiting a variety of primary structures. Some bedded units appear truncated. Infrequently, clay drapes separate bedded or laminated silts and sands. Interbedded organic detritus and rare occurrences of burrows also characterize CH/M. Examples of units fitting this description are illustrated in Figure 23.

Sub-Facies CH/U: The upper CH unit is commonly comprised of structureless silts and clays with minor sand content. Thinly bedded silts and clays with organic detritus or shelly seams are sometimes observed in this sub-unit. Soft-sediment deformation structures are common to



Figure 24. Photograph Core QBP-B-1. Note channel sequence between interval 280 cm to 80 cm. Immature, gray sands are found from 240 cm to 200 cm.

this sub-facies. Roots or plant debris, including leaf impressions and woody debris are frequently found imbedded in the clays. An example of CH/U, described in core QBP-C-2, is comprised entirely of rafted organic debris (Figure 25). Heavily burrowed CH/U units are identical in most respects to bay muds.

Processes: The three sub-facies of lithofacies CH represent different sedimentation rates and degrees of bed shear stress. Medium bedded (> 10 cm thick) sandy units in CH/B and the sedimentary structures indicate comparatively high rates of sedimentation and current speeds. Mud intraclasts ripped from the channel base or walls are added evidence of a high bed shear stress. Immature sands in facies CH suggest that the sediments are not of marine origin. Shells were not described in any CH/B facies.

CH/M contains multiple fining upward sand and silty beds that contain both 2- and 3- dimensional ripples. Interbedded sands and silts separated by clay drapes imply fluctuating current velocities. Stagnating water is responsible for sub-facies CH/U; a fill above the sandier, bedded sub-facies that contains relatively structureless, silty clays with high interstitial water content. Any laminations and bedding are easily deformed due to load-induced dewatering. Rare sandy laminations present in CH/U record short time periods of channel reactivation, perhaps

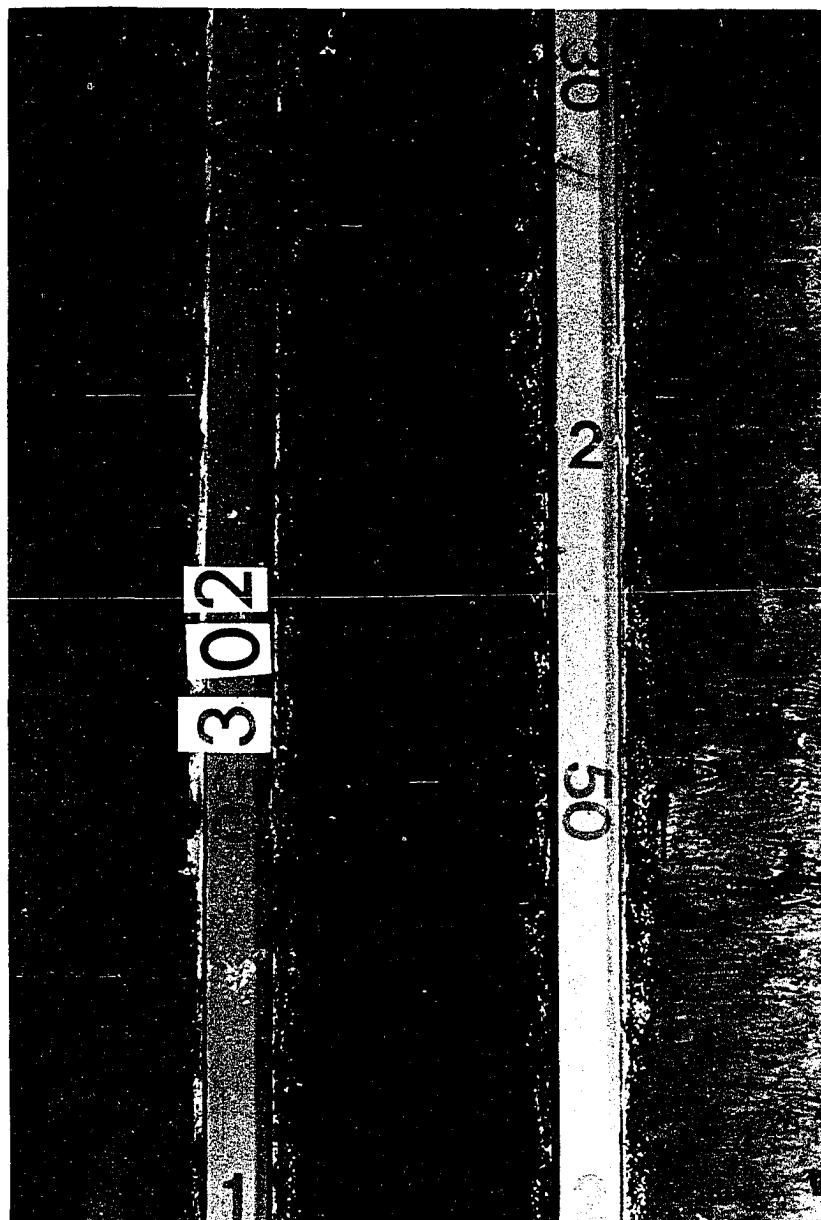


Figure 25. Photograph Core QBP-C-2. The middle segment is comprised entirely of rafted organic/woody detritus.

during high-intensity floods. Plant fragments ,rooting and/or burrowing may be abundant in the topmost layers of the CH lithofacies. Ten to twenty percent burrowing within sub-facies CH-U indicates that sedimentation rates are low enough to allow infaunal communities to thrive.

Interpretation: The three combined sub-facies describe active (CH/B) and abandoned (CH/M and CH/U) channel fill facies. Sub-facies CH/B is interpreted as an Active Distributary Channel. Sedimentary structures that were identified in the active channel facies of the Barataria cores were similar to those described by others in the Mississippi River delta plain (Coleman and Gagliano, 1964).

Active distributary channels contain immature sands rich in heavy minerals. Mineral rich channel sands are colored dark gray to olive/black in the Guadalupe Delta, Texas (Donaldson, 1970) and the Atchafalaya delta, Louisiana (Van Heerden, 1982). Active distributary channel facies were differentiated from tidal inlet sediments in an Eocene delta in Coos Bay, Oregon by Dott (1966) by the absence of heavy minerals in the latter. Deposits described in core QBP-B-1 are consistent with an active distributary channel (Figure 24).

In rare instances the active channel lithofacies directly overlies inferred bayfill lithofacies (Figure 23; QBP-D-3; CR-6). Occasionally, the underlying delta front facies contact appears conformable with the active channel.

All of these attributes have been described in cores taken outside the Barataria area but within the Mississippi River Delta plain (Coleman and Prior, 1980). Sediment sizes of the active channel sub-facies (150 u) contained the coarsest of the non-marine facies analyzed in this dissertation.

Facies CH/M and CH/U were interpreted as Lower Abandoned Channel and Upper Abandoned Channel facies, respectively. The Lower Abandoned Unit contains attributes nearly identical to delta front and proximal overbank facies. The Upper Abandoned sub-facies is basically the same as distal overbank facies or interdistributary bay facies. In fact, without the presence of the active channel facies the combined lower and upper abandoned channel facies are interchangeable with a stacked sequence of proximal and distal overbank facies.

Channel-fill units containing alternating clay, silt and sand layers marks a decrease in discharge and the initiation of channel abandonment (Tye, 1985). When flow through the distributary is blocked the channel will fill with a homogeneous mixture of clays and silts settling from suspension. During high river stages fine-grained laminations may be observed in the abandoned channel facies. However, any bedded material found within the mud dominant facies will likely be deformed (Coleman and Gagliano, 1964; Coleman and Prior, 1980). Plant fragments are abundant in

the topmost layers of Mississippi River delta plain channel fill (Coleman and Prior, 1980), similar to the interval described in core QBP-C-2 (Figure 25).

Channel facies in the Barataria cores range in thickness from 50 to 350 cm with an average thicknesses of 130 cm. This is similar in size to Mississippi subdelta channel thicknesses described by Van Heerden in the Atchafalaya Delta (1982) and in Baptiste Collette crevasse splay (Bowles, 1987). Based on the size of the channel deposited cored in the Barataria area it is concluded that no major abandoned distributary channels were cored. Only sub-deltas or crevasse splays that lay adjacent to main channels were sampled. Later chapters of this dissertation will point out that the dominant distributaries of the Barataria area are presently empty of sediments and occupied by modern tidal inlets.

Lithofacies Overbank (OB)

Description: Lithofacies OB is comprised of stacked graded units in an overall fining upward sequence. Alternating layers of bedded and rooted units are other key characteristics of this lithofacies. Using these primary criteria, two lithologically distinct OB sequences have been partitioned into facies OB-C (coarse) and OB-F (fine).

Lithofacies Overbank-Coarse (OB-C): Lithofacies OB-C is predominantly fine sand/silts interbedded with organics ranging from macerated "coffee ground" material to large (~ 1 cm) pieces of wood. The basal contact of OB-C is commonly sharp and unconformable with the underlying facies. Primary structures in OB-C include a variety of ripples, including climbing ripples and small scale cross-bedding. Ripple-bedded, organic-streaked sandy silts at the base of core PAN-4 is interpreted to be proximal OB (Figure 26).

Distorted but recognizable primary sedimentary structures (Figure 27) and clay draped ripples (Figure 28; QBP-B-1) are less common components of this facies. Facies OB-C normally grades to more heterolithic bedding, i.e. parallel and wavy laminations and lenticular bedding. Primary sedimentary structure is occasionally disrupted by rootlets extending downward from overlying facies (Figure 28; Core QBP-N-3). Sand sizes in OB-C units ranged between 90 μ and 120 μ with.

Lithofacies Overbank Fine (OB-F): Lithofacies OB-F are primarily interbedded silts and clays and, infrequently, thin strata of bedded sands. Without the aid of X-ray radiography this lithofacies can appear structureless. Lithofacies OB-F contains increased amounts of organic detritus and alternating rooted and heavily burrowed strata (Figure 29) when compared to OB-C. The upper contact of OB-C is commonly gradational to marsh.

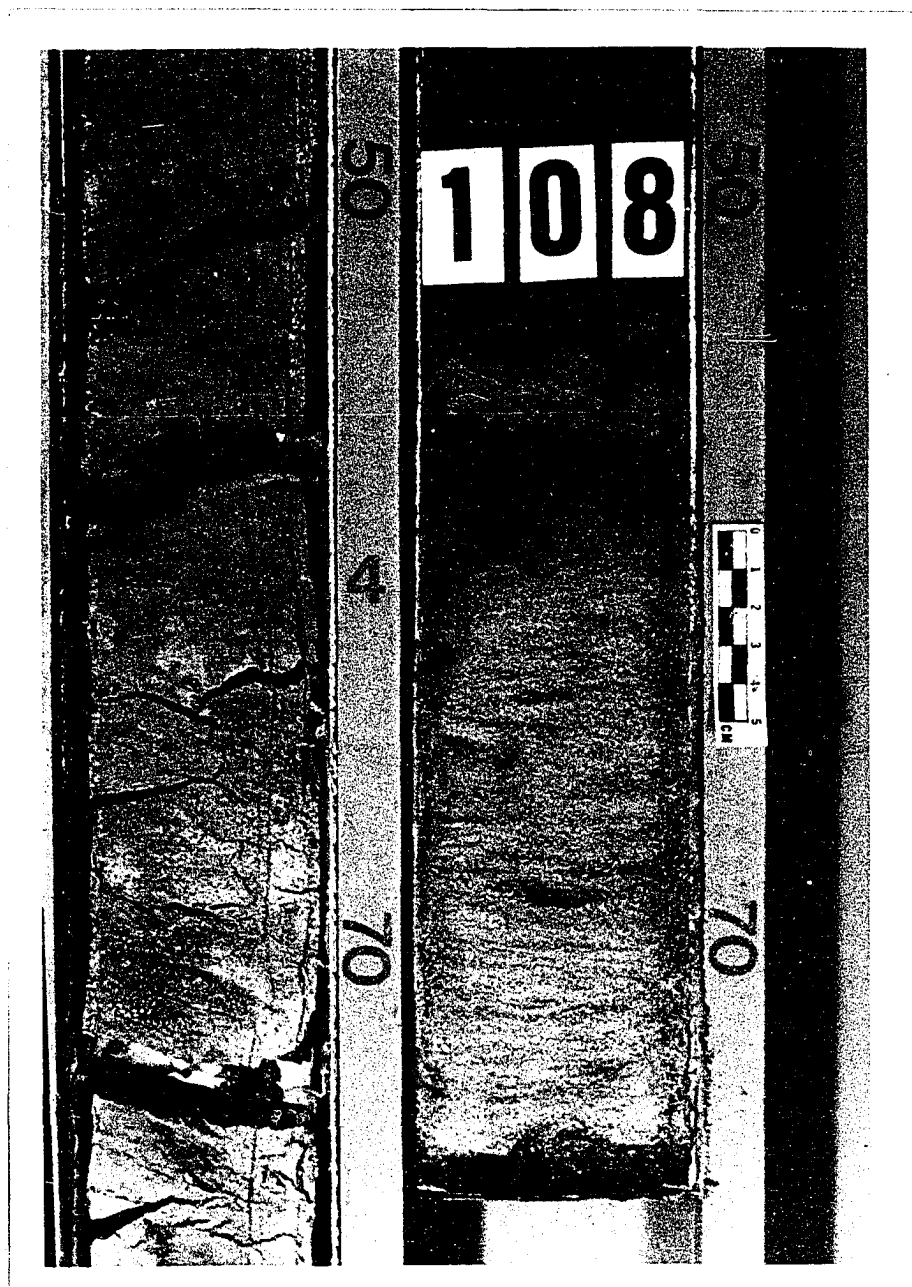


Figure 26. Core photograph of the base of PAN-4. The organic streaked, ripple bedded sandy/silts (4.6 to 4.75 m) have been interpreted as a channel-side subaqueous levee.

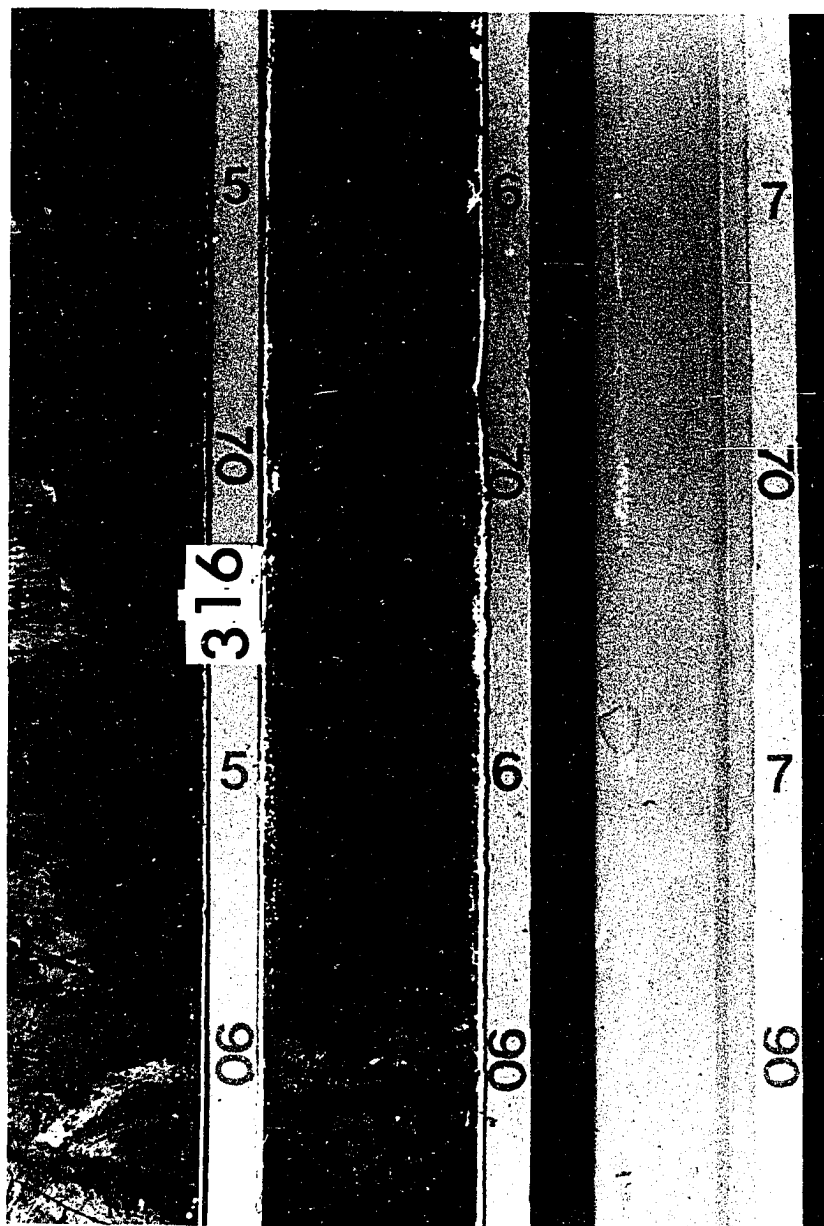


Figure 27. Core photograph of QBP-B-7. The distorted, organic streaked sands (5.7 to 5.9 m) have been interpreted as proximal overbank.

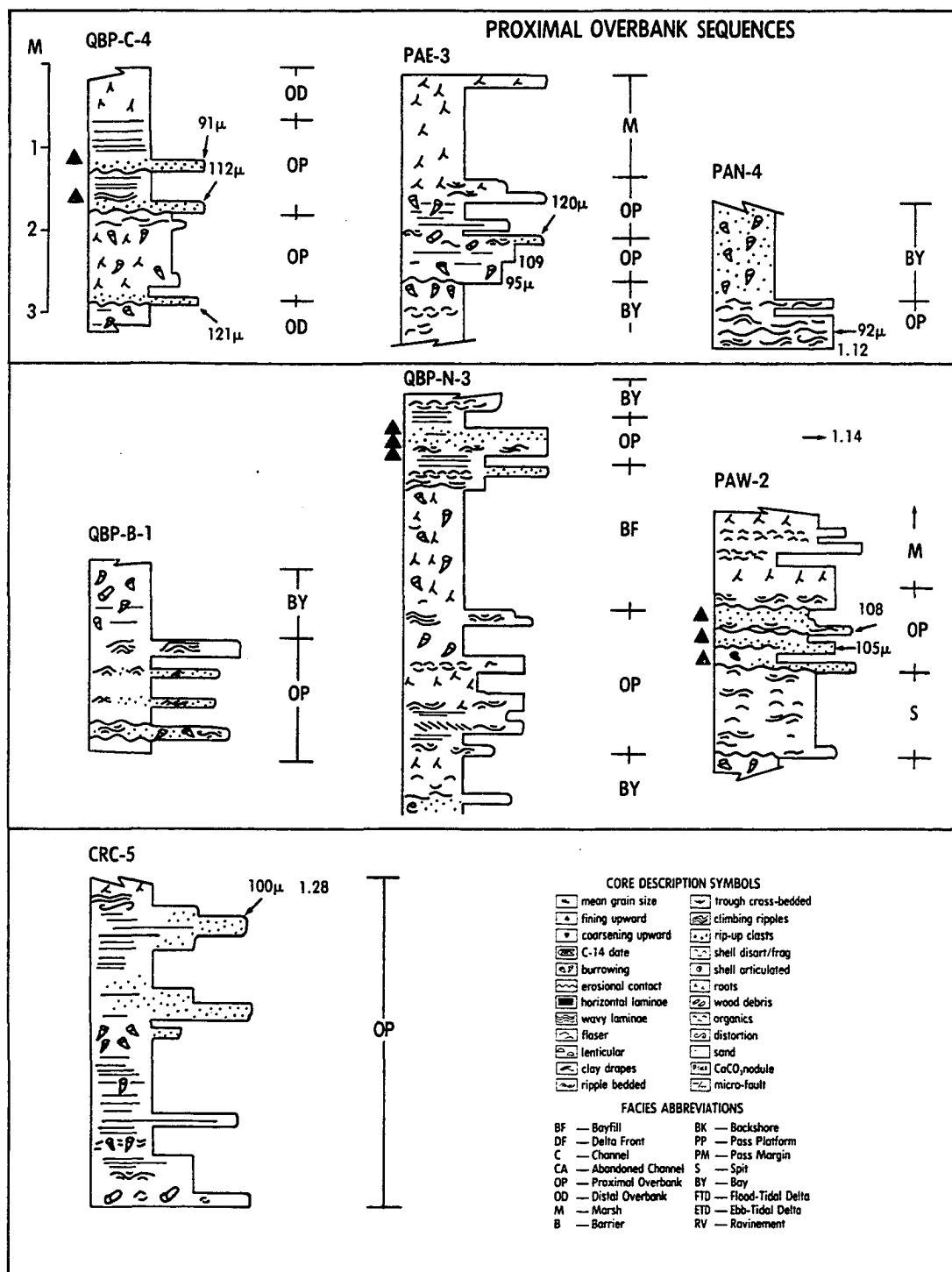


Figure 28. Diagrams of proximal overbank sequences described in core.

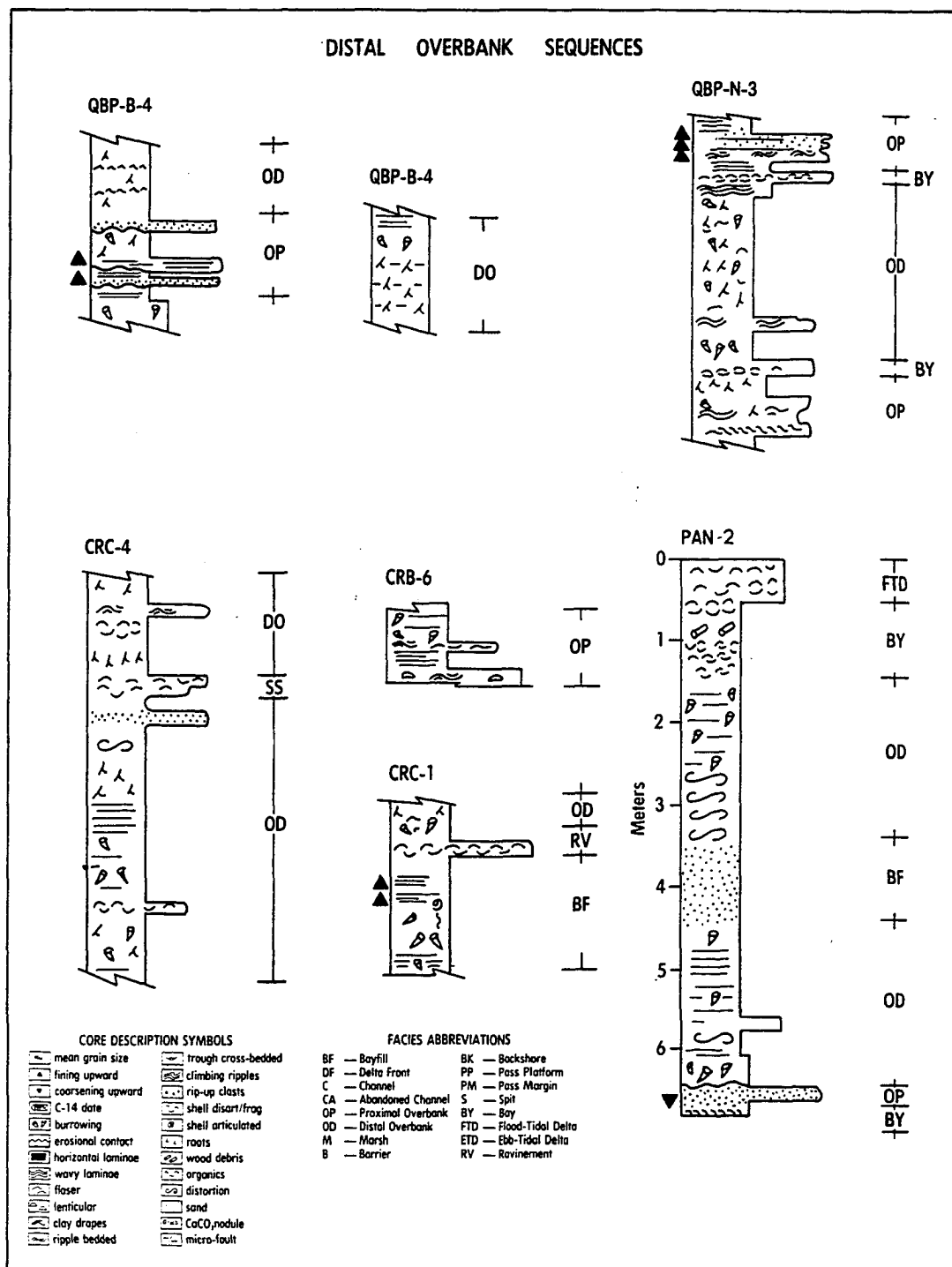


Figure 29. Diagrams of distal overbank sequences described in core.

Lithofacies Overbank - Summary: A complete OB lithofacies is comprised of stacked intervals of OB-C and OB-F that grade from bedded silty/sands to alternating bedded and rooted strata (Figure 30; QBP-N-3). A section of core QBP-C-4 (Figure 31) exemplifies the varied vertical sequences described in OB facies; ranging from immature sands with interbedded, macerated organics to oxidized clay seams. Generally, OB-C sequences exhibit better preserved primary structure and coarser lithologies than in OB-F units. Average thicknesses of an overall OB-C/OB-F sequence is 1.12 m. The thinnest described OB facies is .25 m and the thickest nearly 3.5 m.

Processes: A wedge-shaped body of OB lithofacies was observed in a series of cores taken normal to the present Pass Abel channel thalweg (Figure 32). Ripple-bedded, sandy silts in core PAN-4 correlate laterally to three stacked, fining upward OB-P subunits (25 cm thick) in core PAN-3. Each subunit fines vertically from bedded sands to laminated, lightly burrowed and rooted clays that are more characteristic of OB-D lithofacies. This OB sequence in core PAN-3 interfingers with bayfill in core PAN-2. From west to east the lithofacies are subject to decreasing flow strength.

Distortions described in organic-streaked bedded sands in core QBP-B-7 (Figure 27) were probably caused by

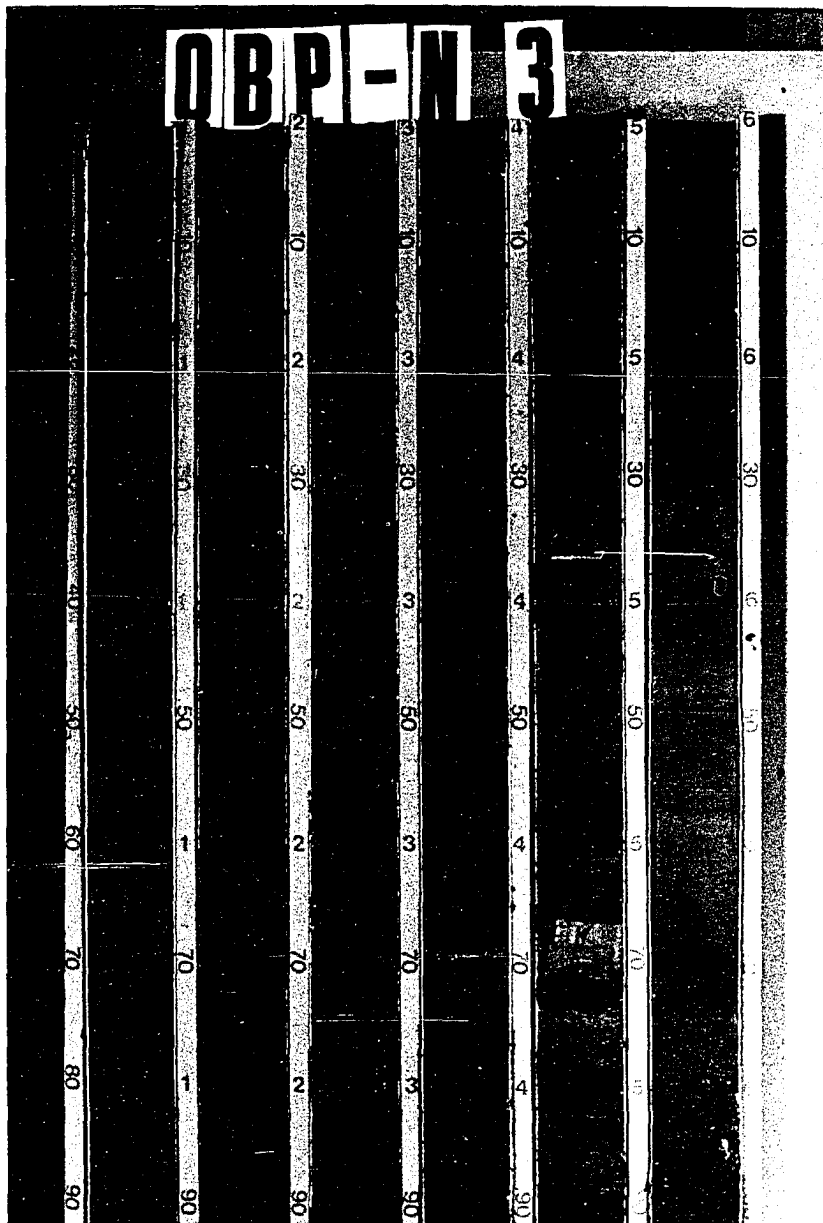


Figure 30. Core photograph QBP-N-3. A normally graded levee sequence fines from proximal overbank, bedded sands (4.5 to 5.0 m) to distal overbank, rooted, burrowed clays (2.0 to 3.5 m).

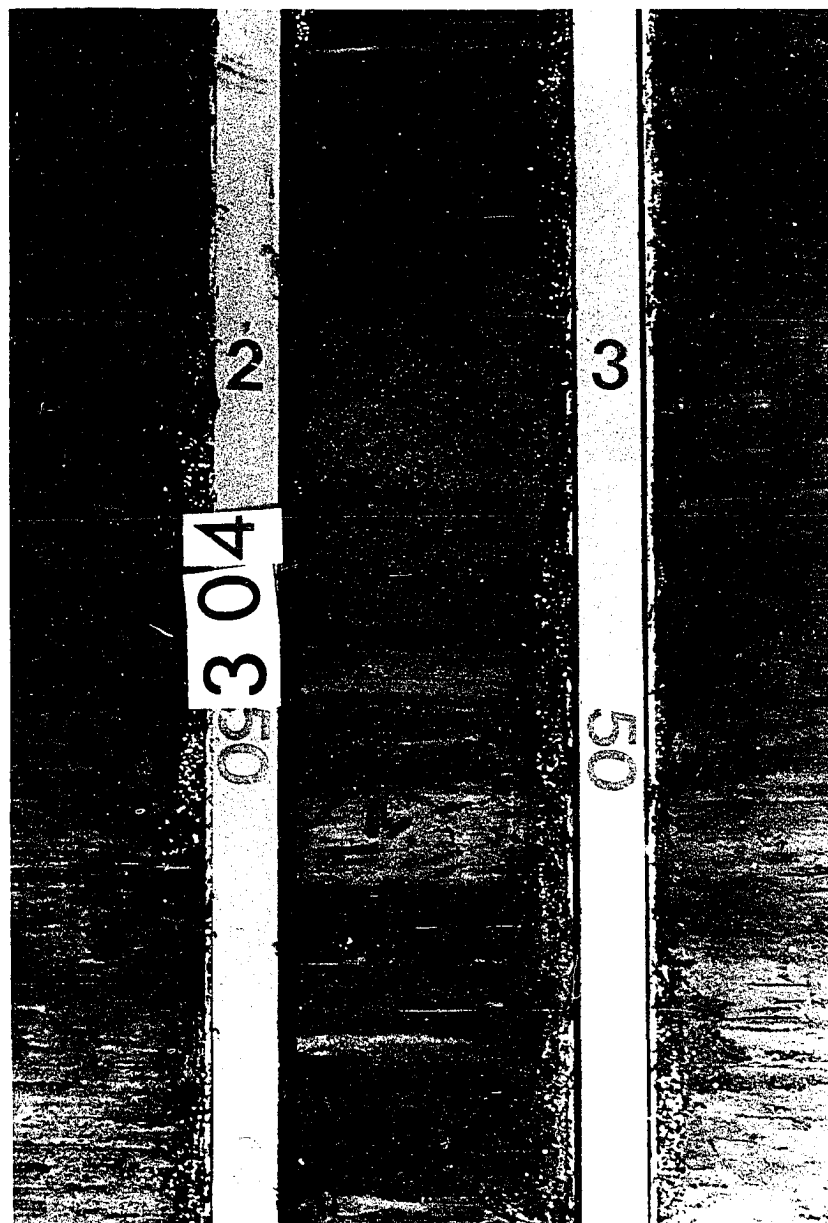


Figure 31. Photograph of overbank sequence in the middle segment of QBP-C-4. The spectrum of hues in this photograph suggests a variety of processes affects the overbank depositional sequence.

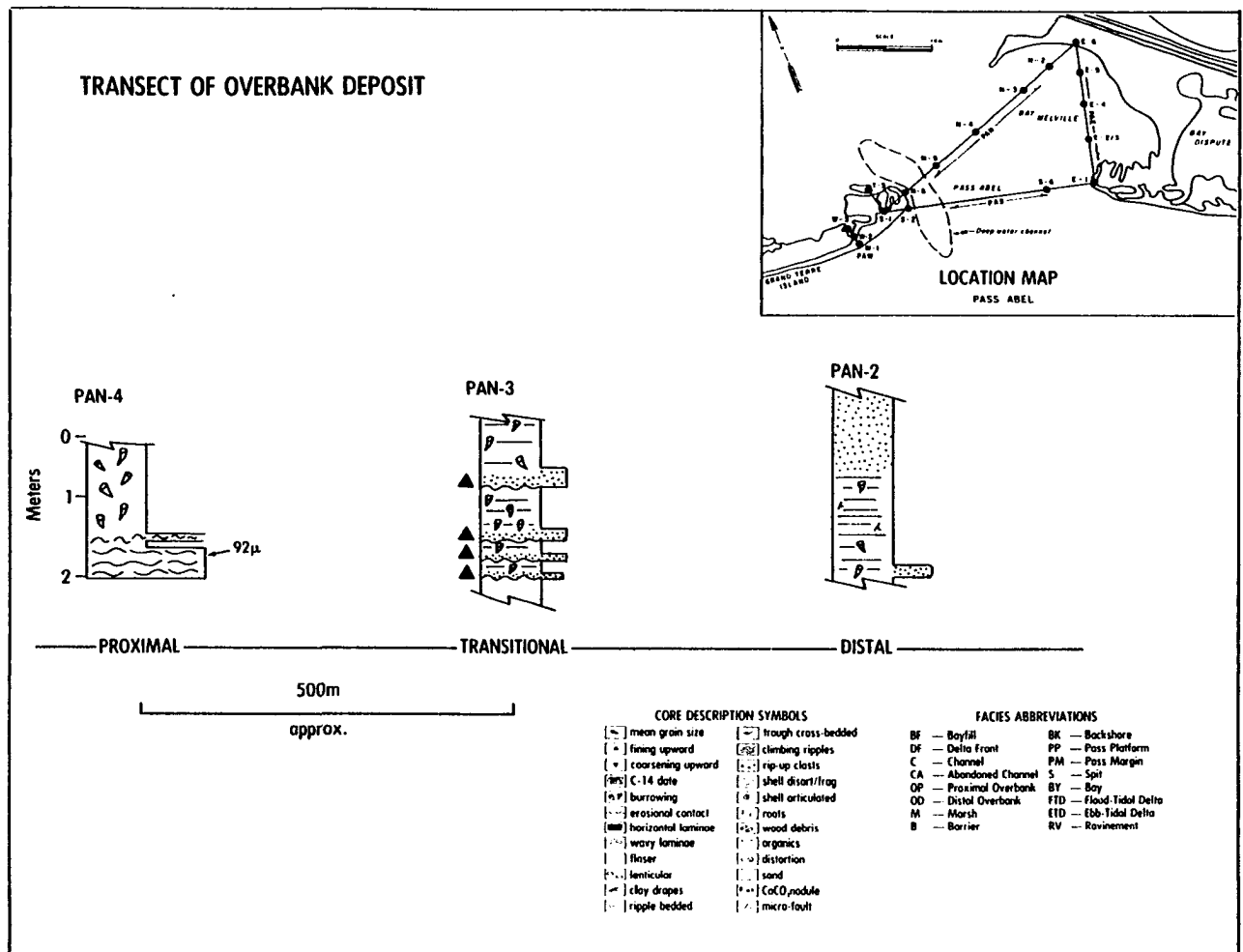


Figure 32. Geologic cross-section from PAN-4 to PAN-2, illustrating a lateral decrease in primary structure and sediment size with distance from the channel located just west of PAN-4.

dewatering and/or slumping. The organics and woody debris are deposited from suspension following a flood event. X-ray radiography frequently reveals strata that are initially ripple-bedded and subsequently burrowed. This sequence suggests that high bed shear stress coincident with high sediment load was followed by intermittent periods of low energy and decreased sedimentation; conditions more conducive for burrowing organisms. Rootlets commonly extended downward from OB-F into the bedded material below disrupting primary structure. Periodic emergence of the facies promotes soil formation, oxidation and vegetation. Interpretation: Lithofacies OB are overbank deposits formed during floods. Similar lithofacies are described wherever channelized flow overtops its banks (Reineck and Singh, 1980). In general, overbank facies described by McEwen (1969) in Coos Bay, Oregon, contain variations in both lithologies and primary sediment structure interpreted as resulting from different magnitude flood events.

Lithofacies OB-C are located near the issuing channel and are termed proximal overbank (OP) facies (Table 2). Levees formed during the early stages of distributary channelization described by van Heerden et al (1981) in the Atchafalaya delta are similar in characteristics to facies OB-P described in PAN-4 (Figure 26). Lithofacies OB-D are located farther from the main channel and are hence termed distal overbank (OD) facies. OD contain higher

concentrations of silts and clays (Reineck and Singh, 1980) are relatively structureless (McEwen, 1969) and have increased organic detritus, rooting and burrow mottling (Kanes, 1970; Tye 1986; Farrel, 1990). Occasional thin strata of laminated sands may be included in the distal facies (Wright, 1985). The interbedded sands are probably deposited during low recurrence interval, high discharge floods. Organic content similar in composition to that described in the Barataria overbank deposits have been reported in other locales (Coleman et al., 1964; McEwen, 1969; Donaldson et al., 1970; Kanes, 1970).

Primary sedimentary structures in overbank facies of the Colorado River Delta (Texas) include small scale cross-bedding (Kanes, 1970). Climbing ripples are a common component of proximal overbank facies in the Atchafalya River delta (van Heerden, 1982). Distorted primary sedimentary structures are common in this facies occurring along the Mississippi River delta plain primarily near to the source channel (Coleman et al., 1964). Heterolithic bedding described in banks of the Mississippi River included parallel and wavy laminations and abundant lenticular bedding (Farrell, 1990). Proximal overbank sequences exhibit better preserved primary structures and coarser lithologies (Van Heerden, 1982; Farrell, 1990) than distal overbank units.

Rootlets were described in the Trinity Delta, Texas

(McEwen, 1969) and in Coos Bay, Oregon (McEwen, 1969) extending downward from the overlying delta plain into overbank facies. Burrowing is also commonly seen in overbank facies (Coleman et al., 1964; Farrell, 1990).

Lithofacies Bay BY

Description: The BY facies are generally homogeneous and fine-grained, with sediment sizes ranging from clays to fine sandy clays (Figure 33). Burrowing was ubiquitous in all BY lithofacies described in the Barataria Bight cores. Dark grays, browns and blacks are dominant hues of this facies. Facies BY is occasionally interrupted by thin strata of silts, sands and shells. Figures 34a and 34b illustrate a variety of Barataria core sequences that include BY lithofacies. The thinnest BY facies was 0.25 m and the thickest 3.0 m. with a mean thickness of 0.97 m.

In the thinly bedded, non-burrowed intervals the primary sedimentary structures observed the most are horizontal laminations and small, clay-draped, oscillatory ripples. Lenticular laminations are rarely present. Large concentrations of small Mulinia were commonly found in dark gray BY clays (Figure 35). However, an X-ray radiograph of an interval of core QBP-B-7 exemplifies an extensively burrowed BY lithofacies devoid of shells (Figure 36). Core CRC-1 (Figure 34a) penetrated a BY unit with an escape structure. The gastropod responsible for this feature failed in its attempt to escape burial. Organic

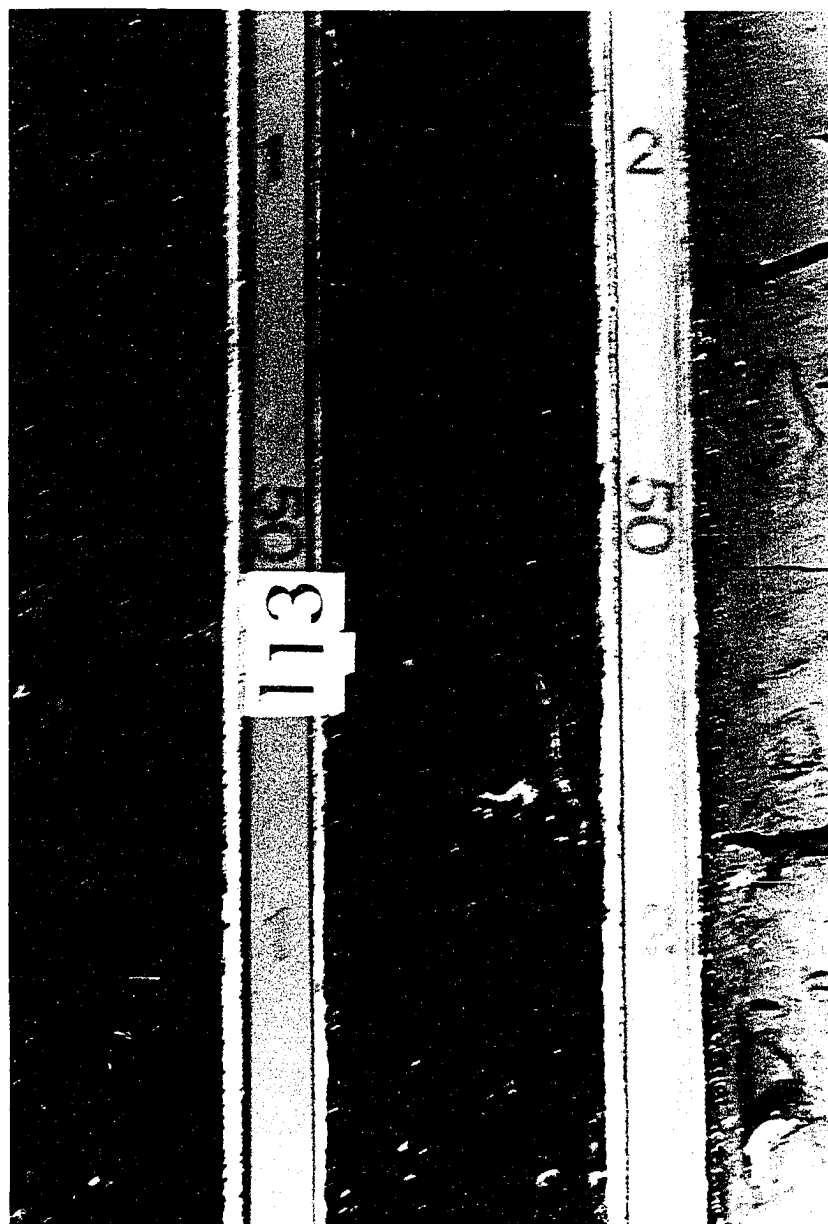


Figure 33. Core photograph PAE-4 ; the center column. Only the disarticulated shell valve disrupts the otherwise homogeneous appearance of the bay interval.

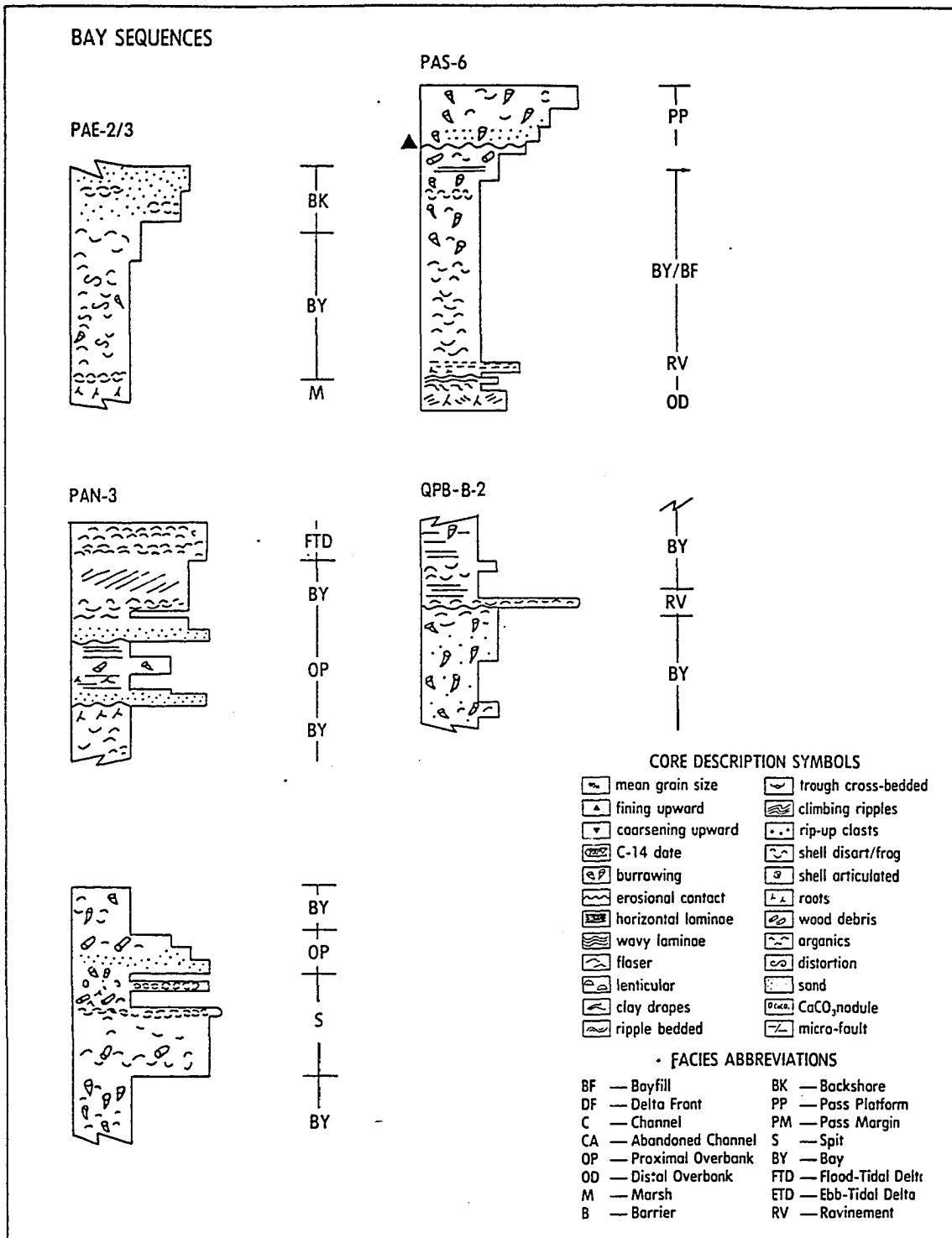
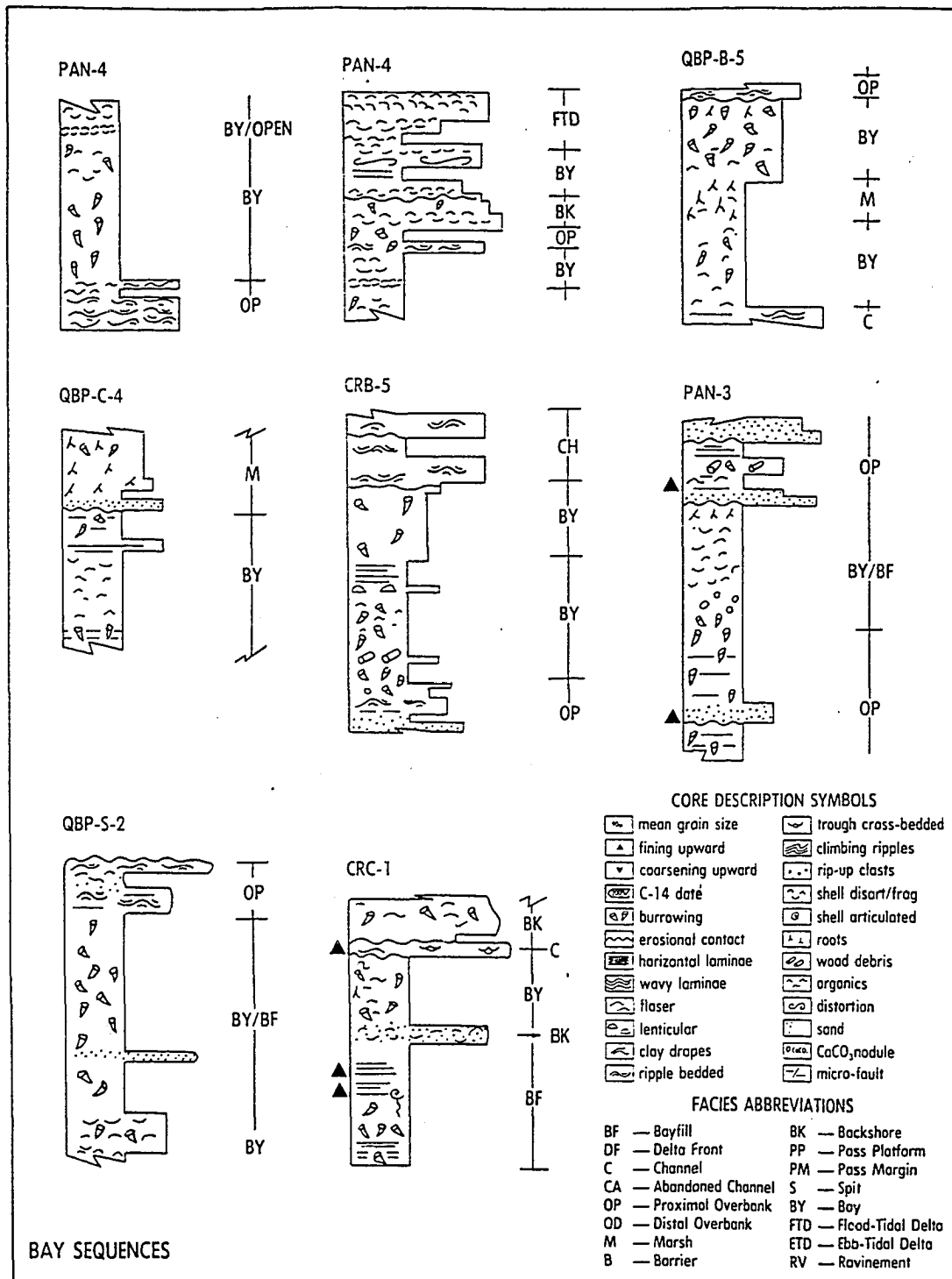


Figure 34 a (left) and b (right). Diagrams of delta sequences from Barataria cores.



rams of described bay



Figure 35. X-ray radiograph core PAE-2/3. The clay matrix contains abundant disarticulated Mulinia sp. valves.

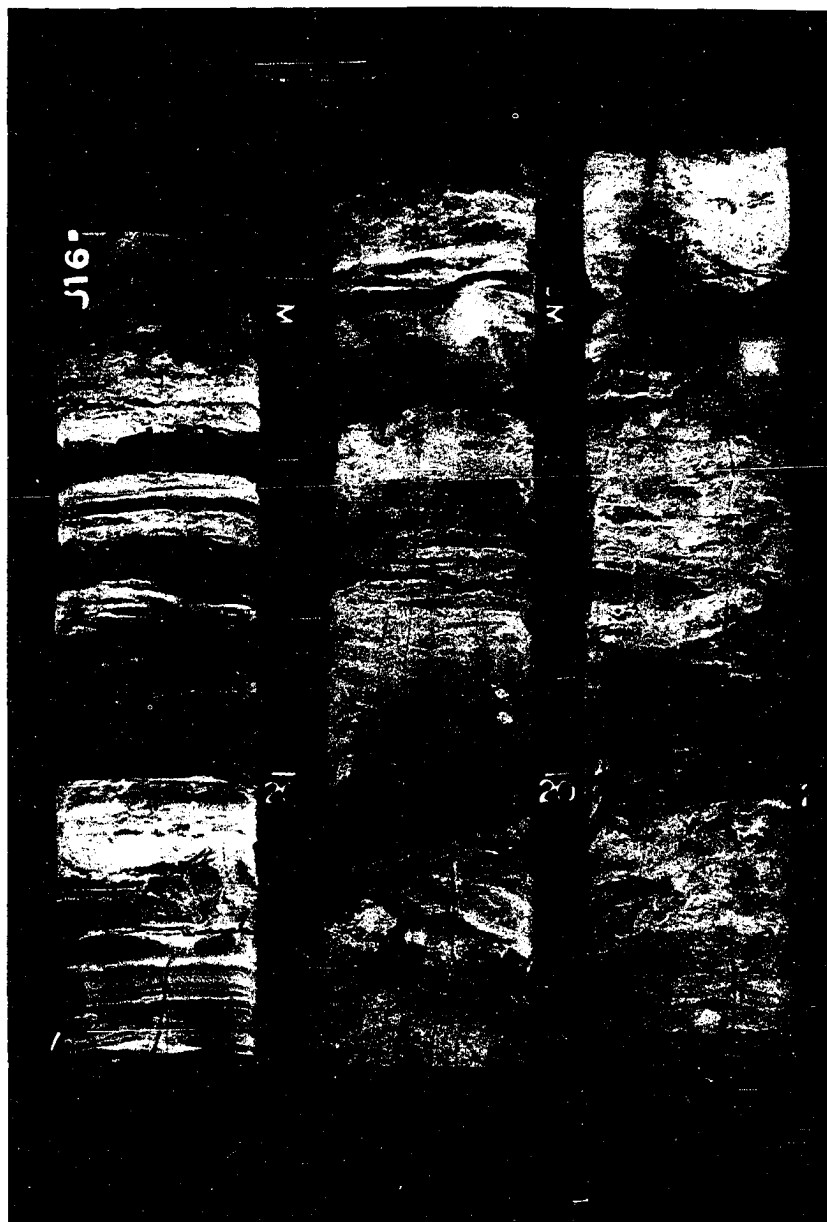


Figure 36. X-ray radiograph core QBP-B-7. Note that this bay sequence is nearly void of shell material. right column 3.30 m to 3.00 m, bay, center 3.00 m to 2.70 m, transition bay to overbank; 2.70 to 2.40 m, distal overbank.

content in this lithofacies is common to rare.

BY facies are overlain by bayfills and marine influenced environments, including flood-tidal deltas (Figure 37), backbarrier deposits, inlet (pass) sands, including recurved spits and marsh. Core PAN-2 (Figure 38) is located 50 m landward of core PAN-3 (Figure 10). In the near future the wave-pushed flood tidal delta sands and shells will be deposited atop the position of core PAN-2, initiating a coarsening upward BY to flood tidal delta sequence. In most cases delta plain marsh lies beneath this facies (Figure 39; PAE-1).

Processes: The fine-grained and burrowed nature of facies BY suggests low sedimentation rates. Homogeneity in the fine-grained unit is the result of bioturbation. Infrequently occurring lenses of clay-draped oscillatory ripples is consistent with the presence of shallow water waves. A mix of shell fragments within facies BY (Rangia cuneata, Mulinia sp., Crassostrea virginica, and Littorina sp.) is evidence of an environment with highly variable salinities. Allochthonous plant detritus was distributed in various concentrations throughout the clay matrix. Conclusively, the environment of deposition for BY facies was characterized by shallow, low energy, brackish to saline waters.

Thin, graded sandy strata that disrupt otherwise fine-grained facies may be the result of rare, episodic increases



Figure 37. Core photograph PAN-4. The top meter of the core demonstrates a gradational change from interdistributary bay to flood tidal delta.

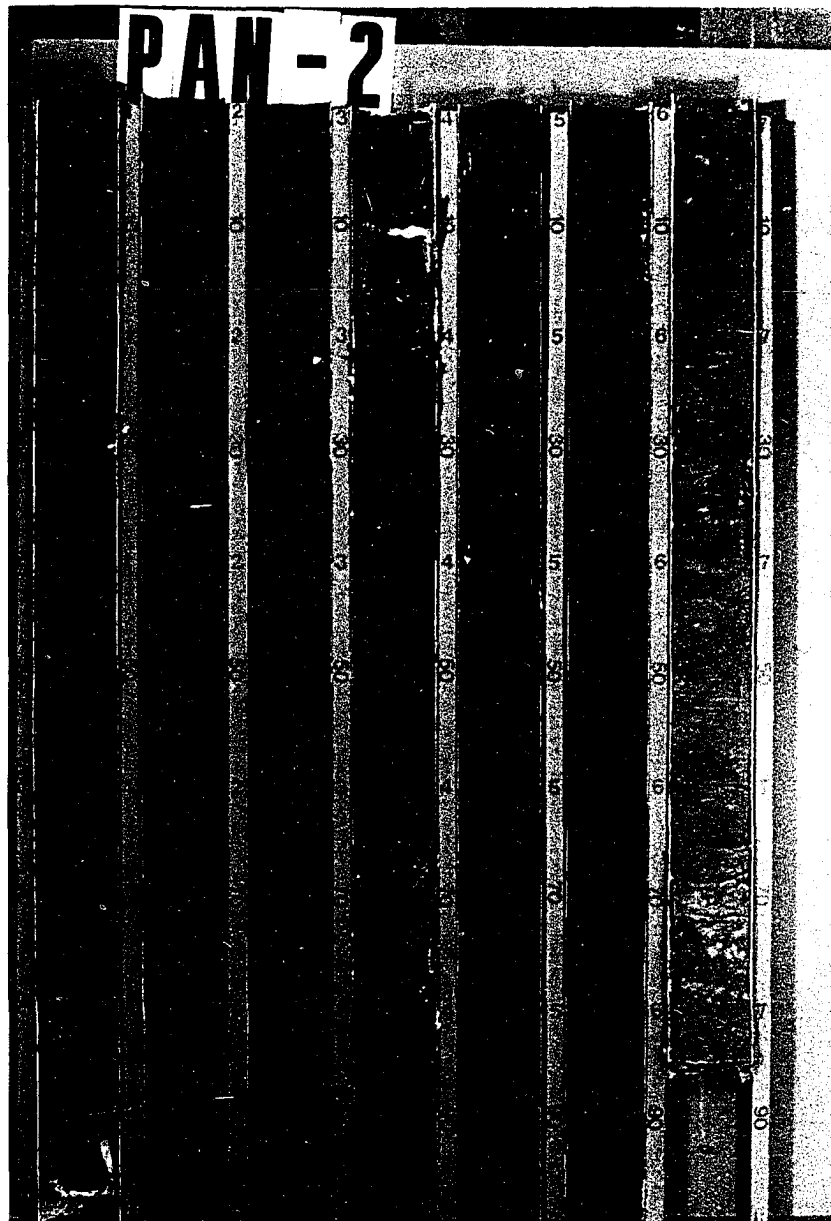


Figure 38. Core photograph PAN-2. The fine-grained interdistributary bay sequence (2.5 to 0.5 m) records a coarsening upward (0.5 m to surface) as a flood tidal delta migrates landward over it.



Figure 39. Core photograph PAE-1. The contact is between marsh and an overlying interdistributary bay. Relative sea level rise was too rapid for the marsh vegetation to keep pace.

in sedimentation rates and bed shear stress. Burrowing will destroy any primary sedimentary structure formed during these events. Concentrations of sands and shells contained in horizontally bedded strata of facies BY are more likely to occur due to wave agitation during a hiatus in sedimentation (Figure 40). A storm deposit may also deposit a similar lag. It is difficult to differentiate between the two possibilities in core.

Interpretation: Facies BY is interpreted to be bay, or interdistributary bay. Rates of sedimentation differentiate bay and bayfill facies. In the bay facies, sedimentation is slow and bioturbation is predominant. Contrastingly, bayfills are subject to higher rates of sedimentation, bioturbation is less prevalent, and primary structure is commonly observed.

Bay muds described in carbonate bay systems in the Pennsylvanian Canyon Group in North Central Texas (Erxleben, 1975) in the Guadalupe Delta, Texas (Donaldson et al., 1966) and more locally in the Mississippi River delta plain (Coleman and Prior 1980) are all extensively burrowed. Kolb and Van Lopik (1966) in their work on the Mississippi River delta plain explained the origin of thin graded sandy strata within bay muds as overbank deposits formed when nearby distributary systems flooded. The presence of primary sedimentary structure in Barataria BY facies was attributed to overbank deposition. Thinly bedded sands and

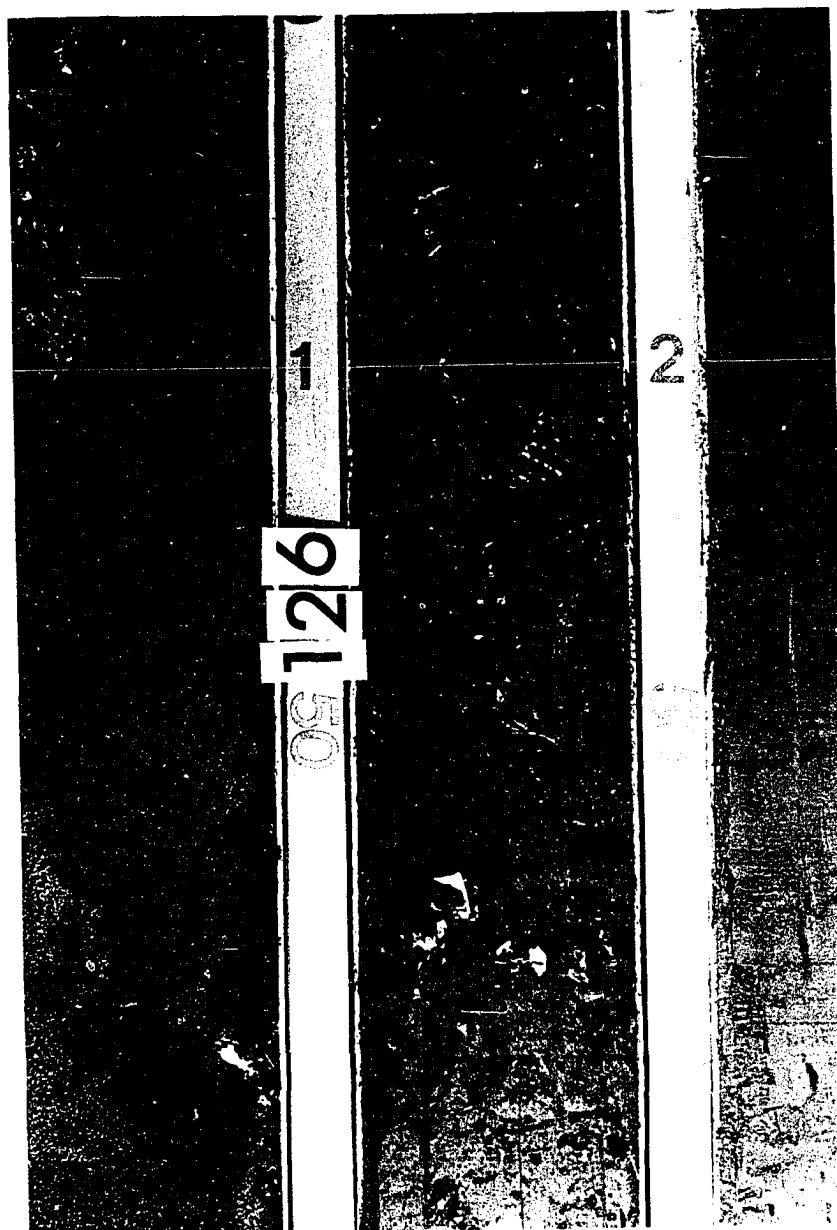


Figure 40. Core photograph PAS-6. The seam of shelly material observed at Interval 1.55 m is a lag accumulated by wave winnowing of the bay facies.

shells found interlayered with burrowed Mississippi River delta bay muds were concentrated by wave agitation of the shallow bay bottom (Coleman and Prior, 1980). Similar, coarse, bedded strata were also described in Barataria BY facies.

Spatial and lateral variability in sand percent within the BY facies is consistent with findings of Kanes (1970) in the Colorado River Delta, Texas. He found that less sand is incorporated in the clays toward the more central, protected portions of the bay. In addition, variations in organic content within this facies are related to the distance of that point in the bay floor from its perimeter. Organic material and sandy clays are more common near the edge of the interdistributary bays becoming rarer near the center (Coleman and Prior, 1980). Shells were described by Coleman (1964) as a common bay mud component. The occurrence of shell fragments within the BY facies was considered one of the key faunal indicators confidently identifying it as interdistributary bay.

Barataria Bight bay facies thicknesses are similar to those described in other areas of the Mississippi River delta by Penland et al., (1988) in Terrebone Bay, Neese, (1984) along the Isles Dernieres and Bowles (1987) in the Baptiste Colette subdelta. For comparison, Guadalupe Delta, Texas bay facies ranged in thickness from 0.3 to 2.0 m with an average of 0.9 m. The average bay thickness in

the Barataria cores was 0.97 m.

Lithofacies Backbarrier (BKBR)

Description: This facies is comprised of stacked sub-units of bedded shelly sands that fine to burrowed muds. The lower, sandy unit may contain laminated muds. Frequently, detrital organics or roots are seen in the upper, fine-grained portion of the sub-unit. In some cases, the fine-grained material is not observed. Scoured bases may sometimes separate successive units of the coarser material. Figure 41 depicts a number of cores that include this facies.

Basal sands within this facies are sometimes inversely graded within the overall, normally graded sequence. The facies are, primarily, horizontally laminated and contains ripple and small scale cross-bedding. The suite of shells represented within this facies, e.g. Mulinia sp, Crassostrea sp, Littorina sp. and Rangia cuneata indicate that their origin was a brackish to marine shallow water environment. In many cases the bivalve shells are whole, non-articulated and not significantly abraded. The presence of shells within the unit is considered a primary characteristic of the BKBR facies (Figure 42). However, absence of shells did not preclude the same determination (Figure 43) provided there was evidence of marine influence in conformable contact within the core. Burrowing

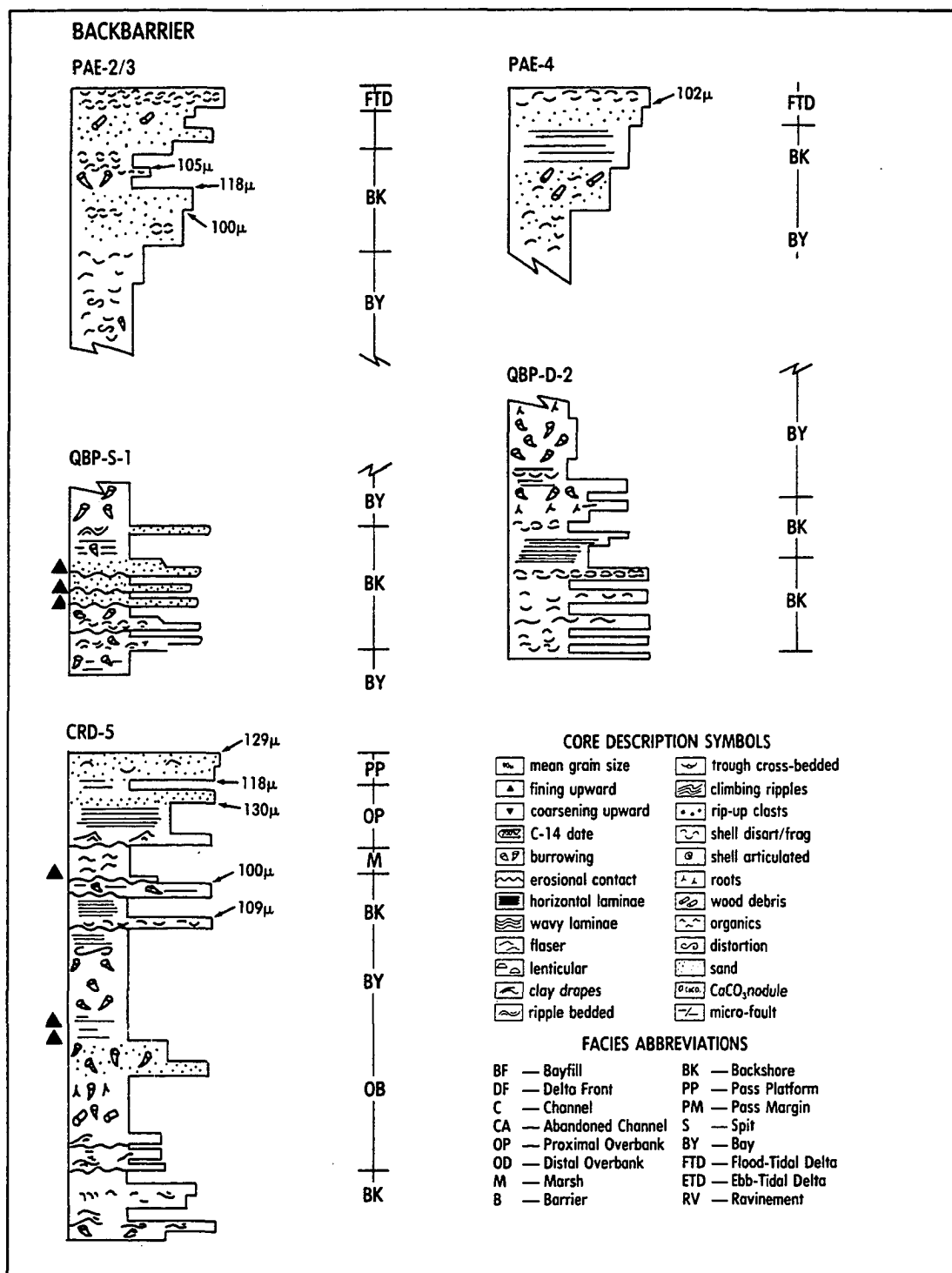


Figure 41. Illustrated examples of Barataria cores that include backbarrier units.



Figure 42. X-ray radiograph of core PAS-6, interval 230 - 200 cm. The rightmost column shows thin seams of bedded shells within the lagoonal unit. Coarser, thicker and more frequent shell seams atop this lower unit (center column) are part of a landward migrating barrier. Pass sediments cap this sequence (left most column).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

and rooting were sometimes described in sands of BKBR facies. Humic staining is left behind following root decay in the sands (Figure 44). Organic content ranging in size from small detrital fragments to woody pieces (Figure 41) were rare to common.

Where the upper, lithologically finer units are preserved burrowing is sometimes noted and extends into the basal sands. Large vertical burrows common to these cored facies were morphologically similar to those built by the fiddler crab Uca pugilator (Frey and Basan, 1985). This organism was found to be a common burrower in washovers fans in Georgian (Frey and Howard, 1969) and Louisiana barrier island systems (Neese, 1984).

The BKBR lithofacies is buried beneath coarser sands of barrier origin (Figure 45) or bay muds. In two instances marsh is covered by BKBR deposits (Figure 46). An X-ray radiograph reveals a series of graded shell strata interbedded with bay muds, probably a transition zone between the BKBR facies and interdistributary bay.

Processes: The imbricated shells described within the medium bedded sands in the sub-units of BKBR are indicative of unidirectional and strong bed shear stress. Internal reverse grading within the overall fining upward sandy unit is evidence of temporal increases in bed shear stress and then decrease. Based upon the shell types found in this

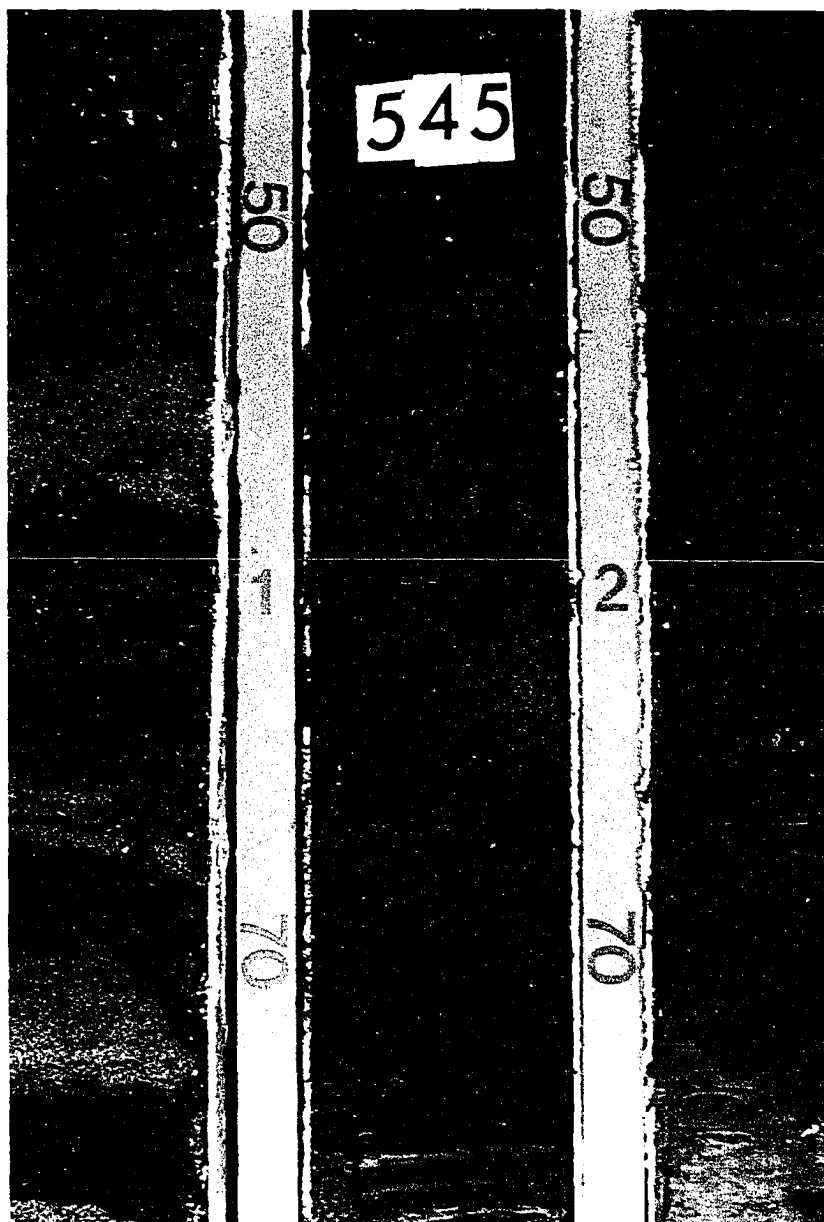


Figure 44. Photograph core CRD-5, interval 170 - 152 cm. The humic staining within this coarse backbarrier unit is the result of decayed vegetation.

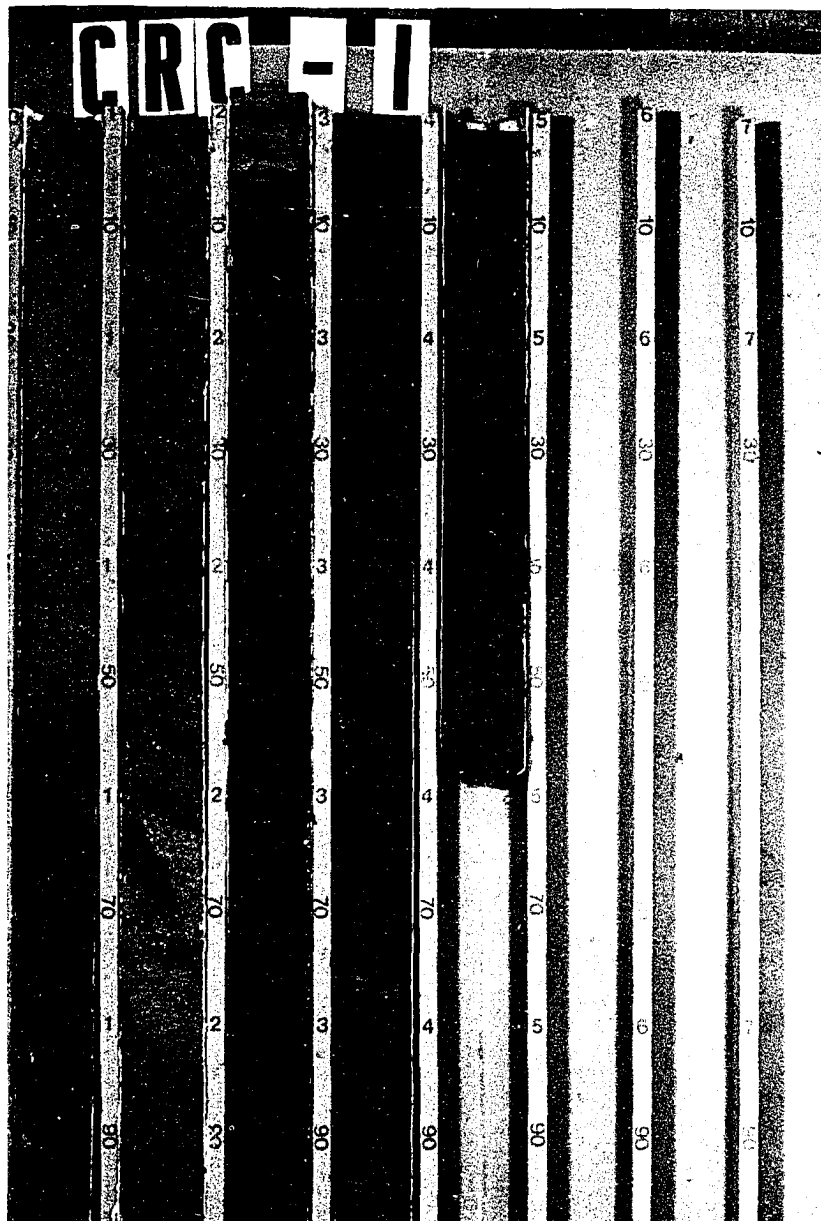


Figure 45. Photograph core CRC-1. Peaty marsh, 300 - 270 cm is overlain by bay (270 - 210 cm), backbarrier 210 - 60 cm, and then barrier from 60 - 0 cm.

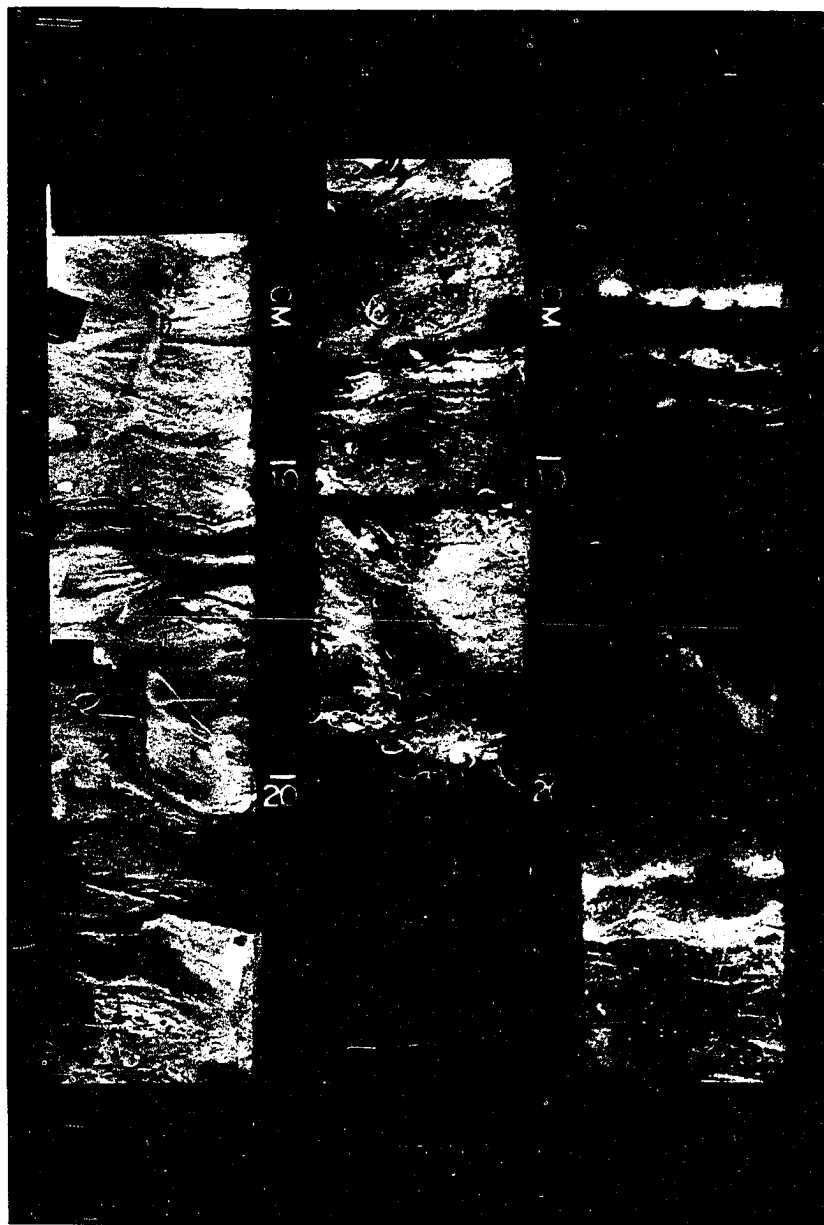


Figure 46. X-ray radiograph of core CRD-4, interval 120 to 60 cm. Organic rich peat (Interval 120 - 90 cm), shelly, sandy clay backbarrier (90 - 60 cm) and burrowed sandy pass floor which is relatively devoid of shell material (60 - 30 cm).

facies, water levels during sand transport are probably shallow and brackish to marine. Following deposition, current speeds relax and water levels drop. This conclusion is drawn from subsequent burrowing of the topmost sands or capping of the sands by rooted muds. Vertical, humic, root stains in the sands indicates oxidation and confirms that the post-burial diagenesis is subaerial. In addition, Spartina sp. roots cannot survive in flooded conditions, therefore the BKBR facies must be predominantly subaerial. Interpretation: Similar lithofacies were interpreted as backshore, washover sequences in Louisiana barrier systems by Neese (1984) and Gerdes (1985). Tye (1985) in his work on South Carolina barriers described washover/backshore sequences with similar ripple bedding and horizontal laminations. These units fined upward from clean medium-grained sands with incorporated, abraded shell material to fine-grained, frequently rooted material. Seams of shells and plant debris are common occurrences in Isles Dernieres overwash sequences (Neese, 1984). Inverse grading similar to that seen in the Barataria backshore lithofacies was documented in Massachusetts washovers by Leatherman (1981). Jeffries (1982) showed that vertical coarsening of washovers was correlated to temporal increases in the frequency of barrier overtopping during Louisiana Gulf storms. Following the storm peak decreases in overwash caused the fining upward sequence to resume. Overwash

units are reworked biogenically between storms often destroying primary structures (Frey and Basan, 1985). Buried, decaying vegetation also left iron staining in North Carolina barrier sediments (Moslow, 1980).

Barataria backbarrier/washover complexes had a range of thickness between .30 m and 1.75 m with an average thickness of 1.03 m. For comparison, a laterally continuous (0.5 km), 1 m thick washover was documented in the eastern Isles Dernieres (Neese, 1984). Andrews (1970) measured washover thicknesses ranging from 0.75 to 1.25 m on St. Joseph Island, central Texas.

Backshore deposits are consequences of landward transport of barrier sediments (Price, 1947; Hayes, 1964) caused by hurricanes and storm related waves (Reineck and Singh, 1980). Overwash dominates sediment transport within Louisiana low-profile barriers (Jeffries, 1982; Ritchie and Penland, 1985). Davies et al., (1971) maintains that backshore sequences are overlain by saltmarsh or lagoonal sequences. This may be the case where the dominant sediment transport is longshore along the face of the barrier. However, frequently overwashed backbarriers are capped by landward migrating barrier sands.

Classic definitions position the barrier backshore between the supratidal berm crest and fore dune ridge (Elliott, 1978). It is dry except under unusually high water conditions (Hayes et al., 1975) and subject to eolian

sand transport (Reineck and Singh, 1980). This definition applies to high-profile barriers and is not apt for Louisiana low-profile barriers (Morton, 1979). The Barataria Barriers are thin, with maximum beach widths of 25 m, and crest elevations less than a meter (Nakashima, 1988), making them extremely susceptible to overwash (Ritchie and Penland, 1985). The backshore described herein is located between the berm crest and either marsh or a lithologic transition zone with the bay muds (Figure 47).

PART II. SUBSURFACE CHARACTERIZATION OF EXPOSED ENVIRONMENTS

The tops of the vibracores taken in the Barataria region were analyzed and assumed to be representative of the environment exposed at the surface. In this part of the chapter, these depositional environments are described in terms that allow them to be recognized in the subsurface (Table 2).

Marsh

The marsh lithofacies is comprised of thick-bedded (>20 cm) muds containing at least twenty percent rooting. The twenty percent was arbitrarily chosen for this work. Finer differentiation between marsh types as outlined by Kearns (1985) was not incorporated into this research. The

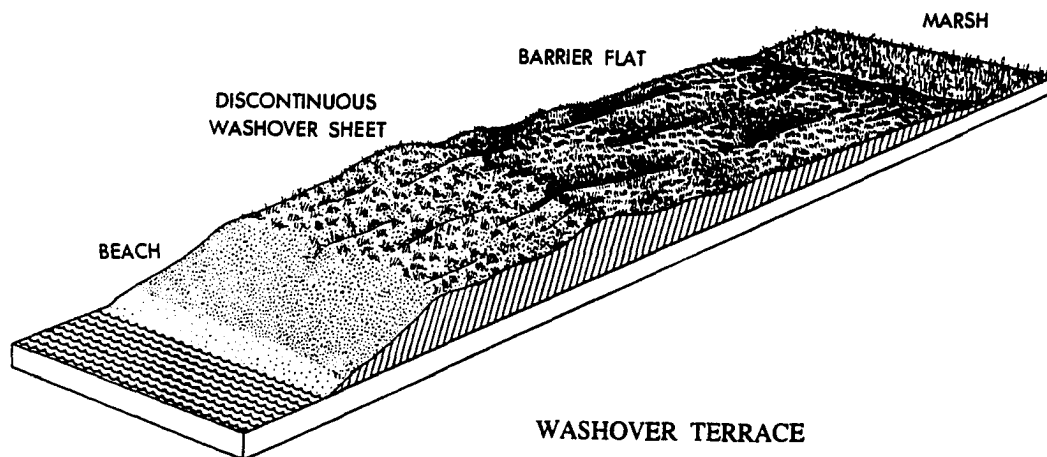


Figure 47. Profile of low-profile barrier and typical morphological zonation. (Modified from Morton, 1979).

sediment consistency ranges from a watery organic ooze to firm silty/clays. Sandy laminations, although rare, are the only primary bedding feature observed within this unit. Higher sand content was observed where modern marsh facies were in direct contact with open water channels or bays. Structure of the marsh facies is nearly always homogeneous but may appear mottled. An X-ray radiograph of a buried marsh unit (Figure 48) illustrates the predominance of root structures. The average marsh thicknesses measured in the Barataria Bight cores was .90 m with a range of .25 to 2.00 m.

Spartina alterniflora is the most commonly observed plant in the marsh facies. Detritus trapped between the plant stems is identified as remnants of deteriorating marsh grasses. X-ray radiography indicates that early diagenesis, including pyrite and siderite replacement surrounds the roots in buried marsh lithofacies. In addition to being heavily rooted this facies is also extensively burrowed. Burrows observed in X-ray radiography are usually vertical and lined with silt and/or fecal pellets. Shells, which were rare, are identified as Mulinia sp or Crassostrea sp., both brackish water fauna.

Marsh facies described in this suite of cores lie conformably above bay environments, overbank deposits, and channel fills (Figure 49). Where they are buried, upper marsh contacts always appeared sharp (Figure 50). Where

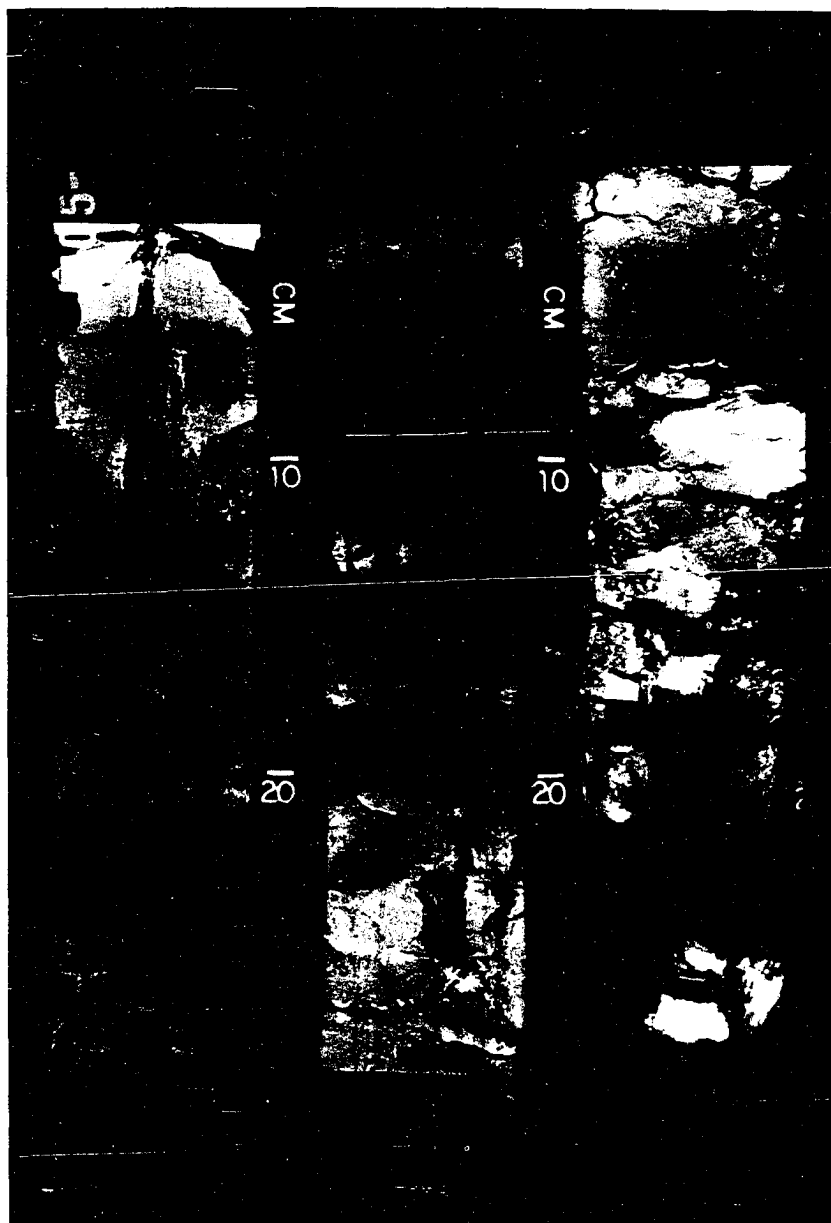


Figure 48. X-ray radiograph of marsh unit. The left two columns are spartina/root mottled marsh from core PAS-1, interval 2.00 m to 1.05 m. The coarsest roots are observed toward the top of the marsh, which is buried beneath a sandy spit.

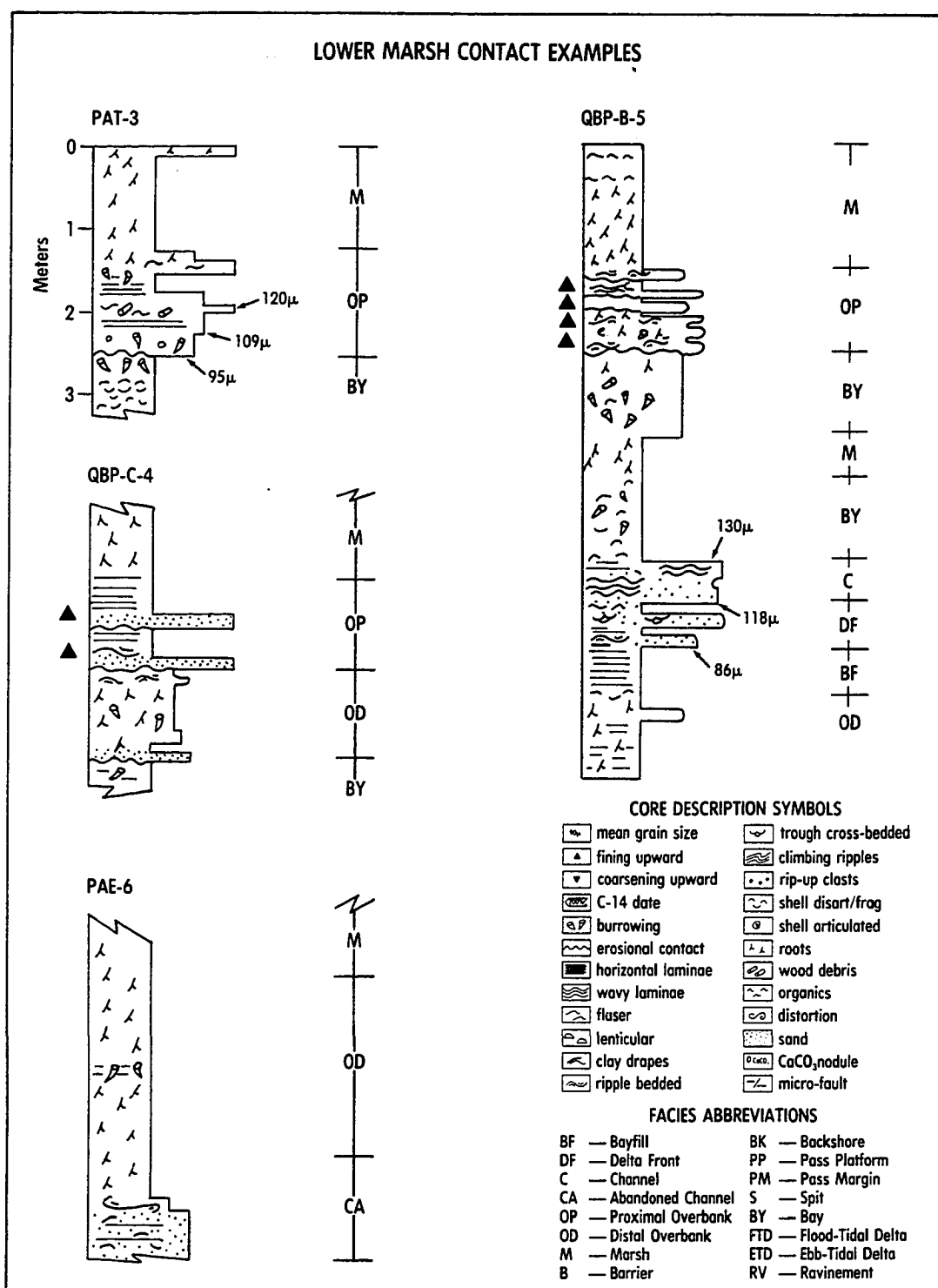


Figure 49. Illustrated examples of low marsh sequence basal contacts.

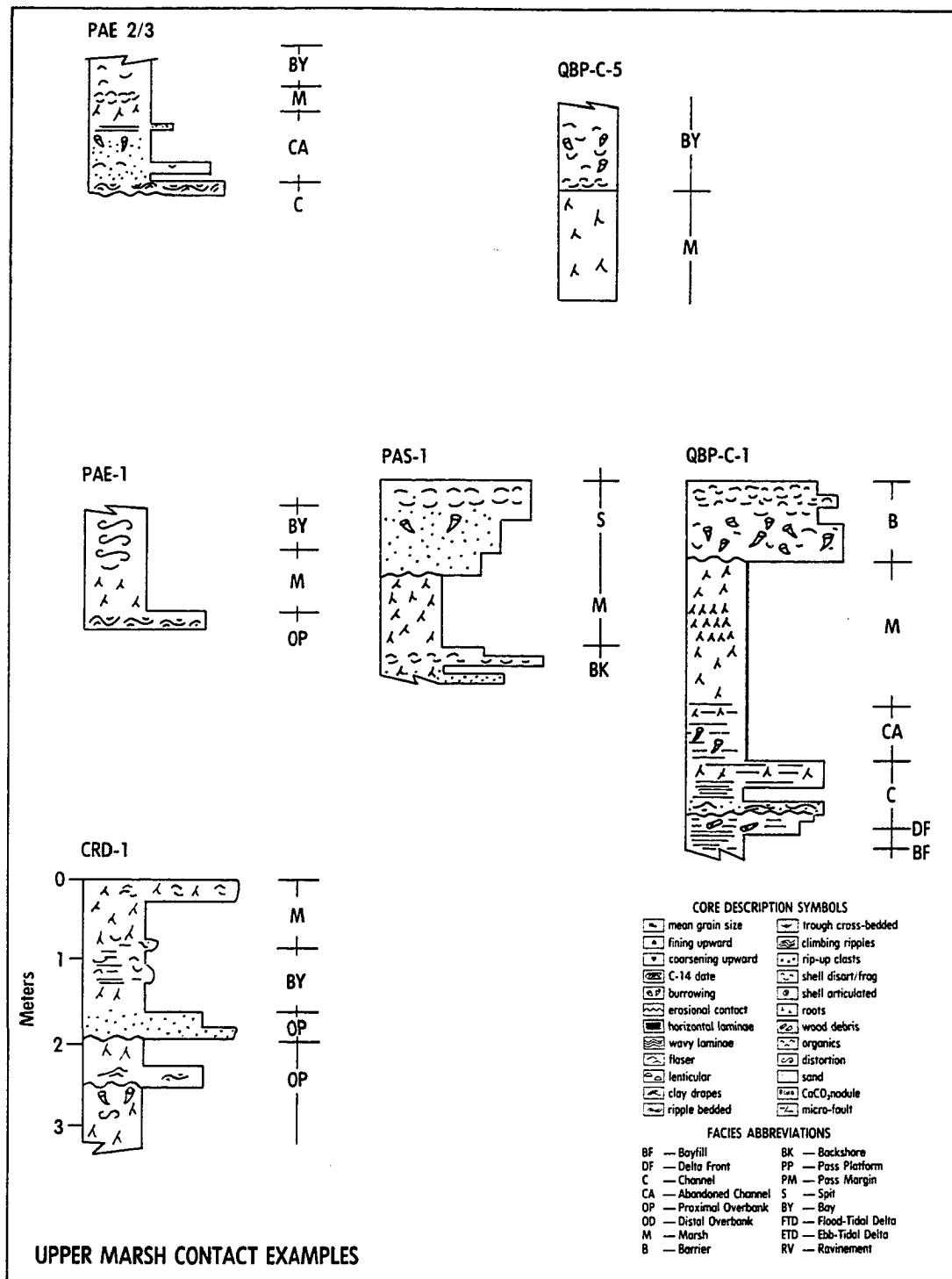


Figure 50. Illustrated examples of low marsh sequence upper contacts.

subject to overwash the covering material was coarser transgressive beach sands. Gradational vertical changes were observed primarily where the marsh was buried by bay clays. An example of this was seen in core CRD-4 (Figure 51). Sharp contacts occurred where barrier sands migrated landward or laterally over backbarrier fringing marshes (Figure 52).

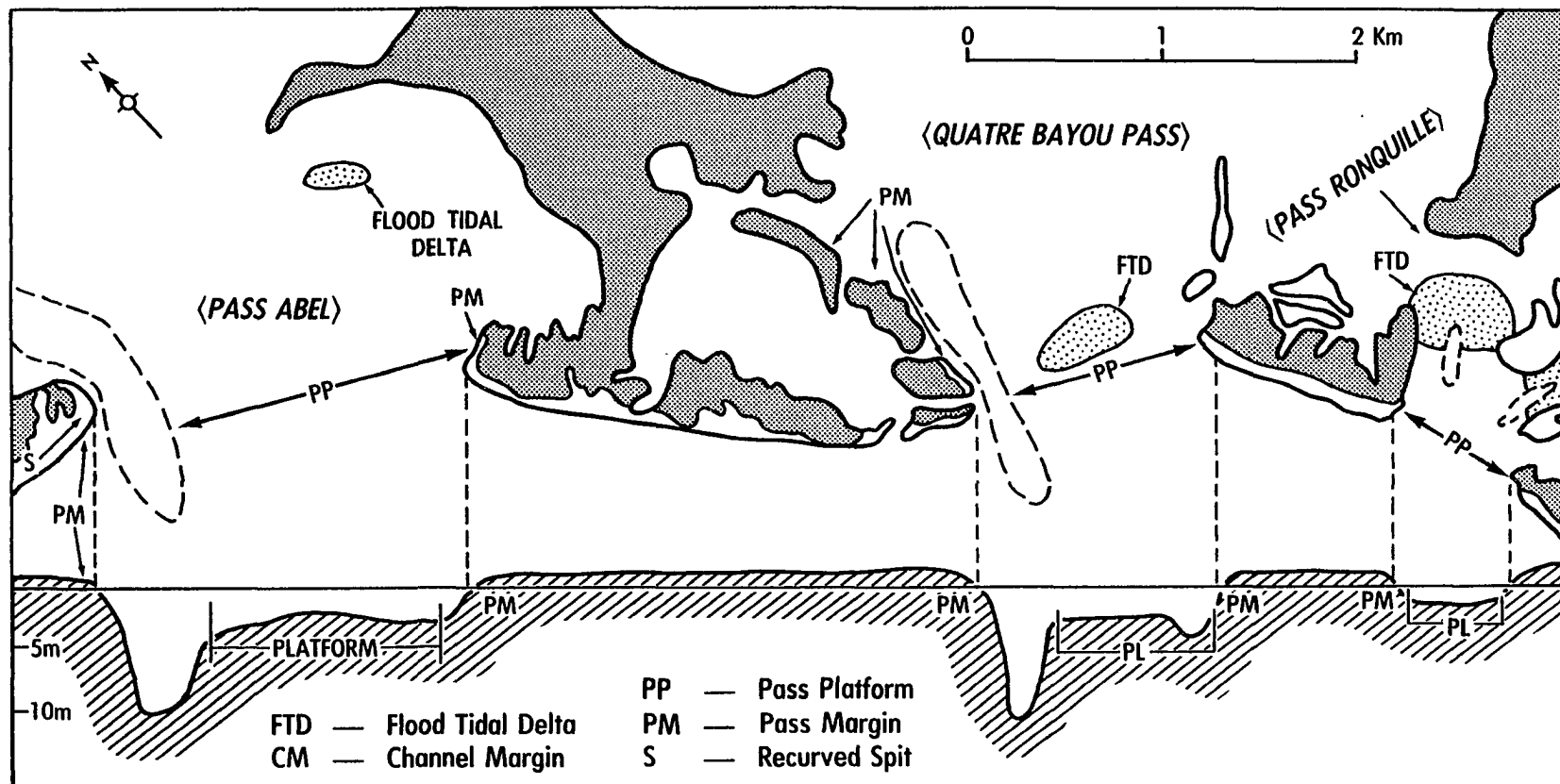
Fine-grained silt/clay lithologies combined with intensive burrowing, rooting and a general lack of physical sedimentary structure are all indicators of a low energy, subaerial environments. Shear stress is negligible and sediments settle from suspended load. Spartina alterniflora identified as the dominant marsh vegetation, is a subaerial brackish to saline tolerant plant that cannot survive prolonged submersion (Frey and Basan, 1985). It is the most common grass of the Louisiana delta plain marsh (Day et al., 1973).

Spartina grasses can reduce wave energies up to 92 % (Wayne, 1976) so that wave entrained materials entering the marsh area will be deposited. Channel overbank deposits or incidental wave overtopping may cause silts or sands to be trapped among the vegetation. Algal, bacterial, and diatomaceous films help trap and stabilize the sediment substrate (Blum, 1968; Warme, 1971; Day et al., 1973).

Marsh fauna along the eastern seaboard is dominated by the fiddler crab, Uca sp. (Frey and Basan, 1985). Uca



Figure 51. Core photograph CRD-4. Note sequence from interval 1.2 m to surface where a marsh is flooded by the overlying bay (1.0 m) and then the pass floor (0.4 m).



COASTWISE CROSS SECTION COMPARED TO AERIAL VIEW

Figure 52. Distribution of depositional environments within the Barataria shoreline area.

pugilator (Fiddler crab) is ubiquitous along the Louisiana and Texas Gulf coast, (Kanes, 1970). Its burrows are single tubes, unbranched, vertical to slightly inclined up to 3 cm in diameter and decimeters in depth (Basan and Frey, 1985). These and other burrows are usually silt filled (McEwen, 1969) and/or lined with fecal pellets (Kanes, 1970). The large armies of fiddler crab observed populating the marshes during this program's field effort suggests that chitinous shell fragments, if preserved, would be a key descriptor of the Louisiana low marsh environment. However, despite their surficial abundance they were not observed in any Barataria core. Shells may be present in marsh deposits (Kanes, 1970) but have been classified as rare by Coleman et al., (1964). The basal contact of the low marsh is likely to be gradational from bay facies (Laury, 1968; Donaldson, 1970). In the Colorado River Delta, Texas the marsh system was predominantly overlain by bay deposits (Kanes, 1970). Where the marsh was subject to overwash from a nearby barrier system the covering material was coarser transgressive beach sands (Kanes, 1970). Similar sequences are seen in Barataria Bight cores.

Tidal Pass Lithofacies

There are a number of sub-environments within the general tidal passes. The tidal pass, or inlet, is defined

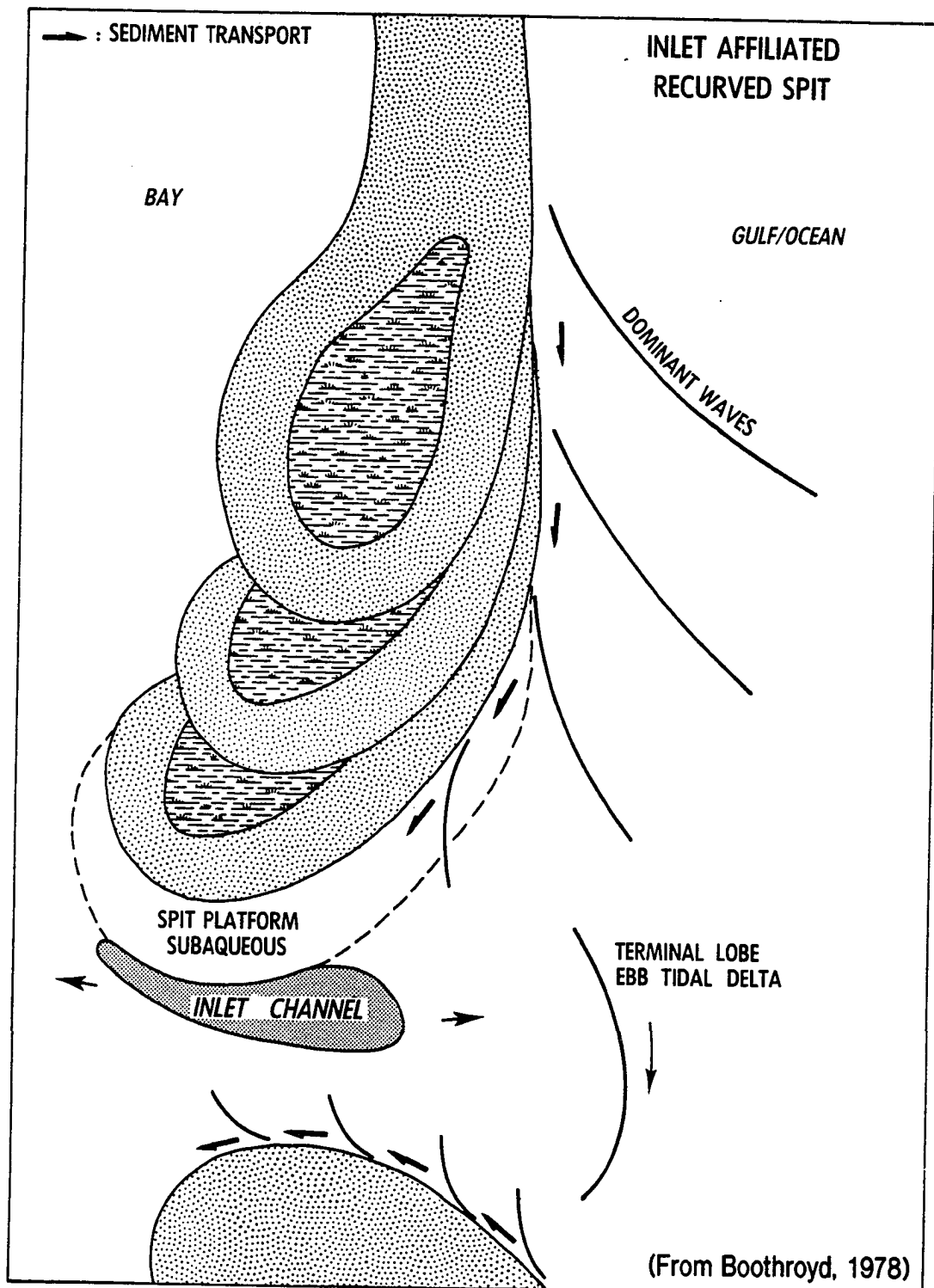


Figure 53. Inlet associated components of a recurved spit (modified from Boothroyd, 1985).

herein as a connecting channel that exchanges tidal water (mostly of marine origin) between an ocean and a landward bay or lagoon. Components of the inlet environment described in this dissertation include: recurved spits, the pass platform, pass channel margins, and flood-tidal deltas (Figure 52).

Recurved Spits

Geomorphology: Barrier spits are ridge-like accumulations of sand that build from headlands into deeper water in the direction of longshore sediment transport (Kumar and Sanders 1975). Spits commonly bound inlet tidal channels (Boothroyd, 1985). They are best developed on their updrift sides (Hayes and Kana, 1976). Wave refraction around the terminus of the barriers (Evans, 1942) or wave attack from different directions (King and McCulloch, 1971) may cause the terminal ends of both barriers to arc landward, forming recurve spits (Figure 53). The spit may occur as an intertidal or entirely subaqueous platform (Hoyt and Henry, 1967; Kumar and Sanders, 1975).

The eastern spit of Grande Terre is the only barrier spit example in the study area. Its sandy surface is predominantly free of vegetation, except for sparse patches of Spartina alterniflora and littered with rafted debris. Spits along the Louisiana coast are relatively non-vegetated owing to their low profile and dynamic processes (Neese, 1984). The maximum spit elevation at

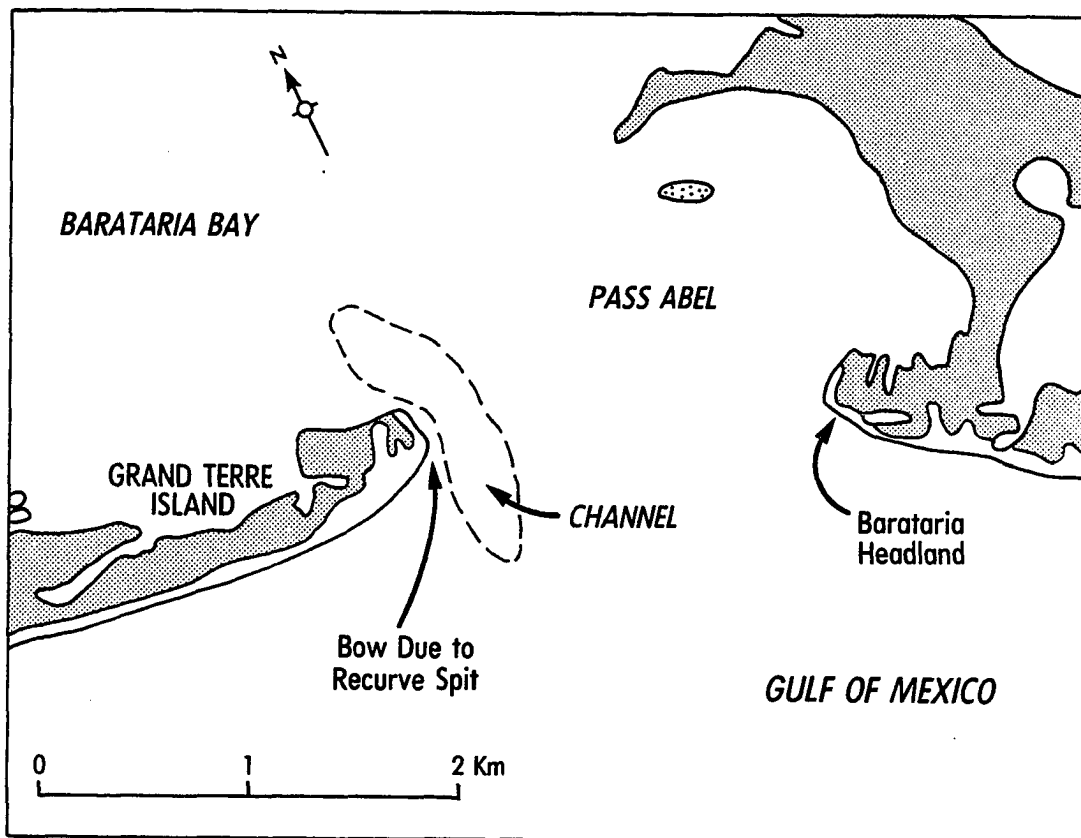


Figure 54. Diagram of Grande Terre recurve spit impinging upon the Pass Abel channel. Dominant eastward longshore sediment transport is causing the middle reach of the inlet channel to bow slightly to the east.

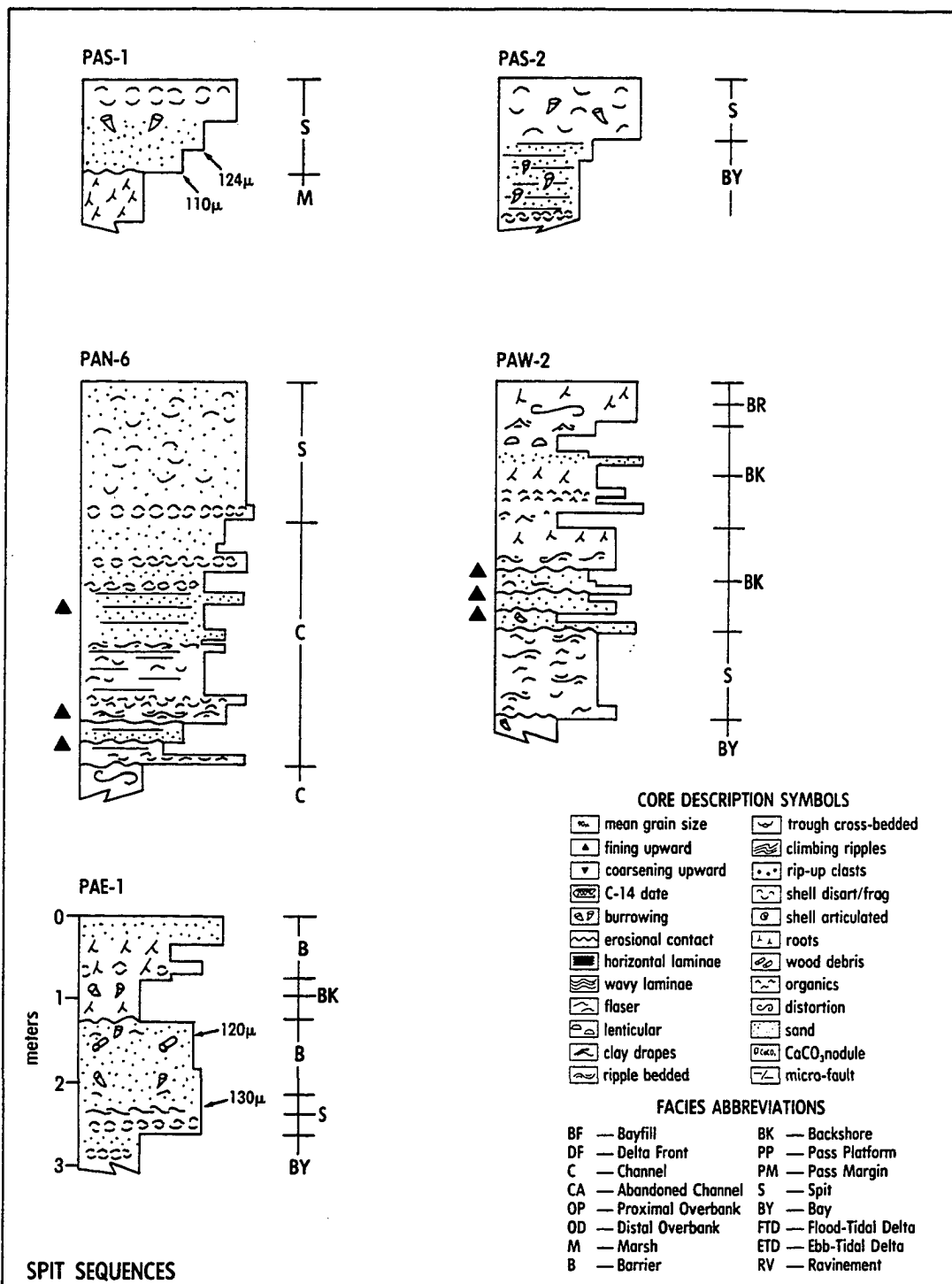


Figure 55. Diagram of spit sequences described in the Barataria cores. In most cases the coarser, sandy spit units was preceded by a fine-grained depositional environment. Core PAE-1 and PAW-2 contained the only examples of spit facies preserved in the subsurface.

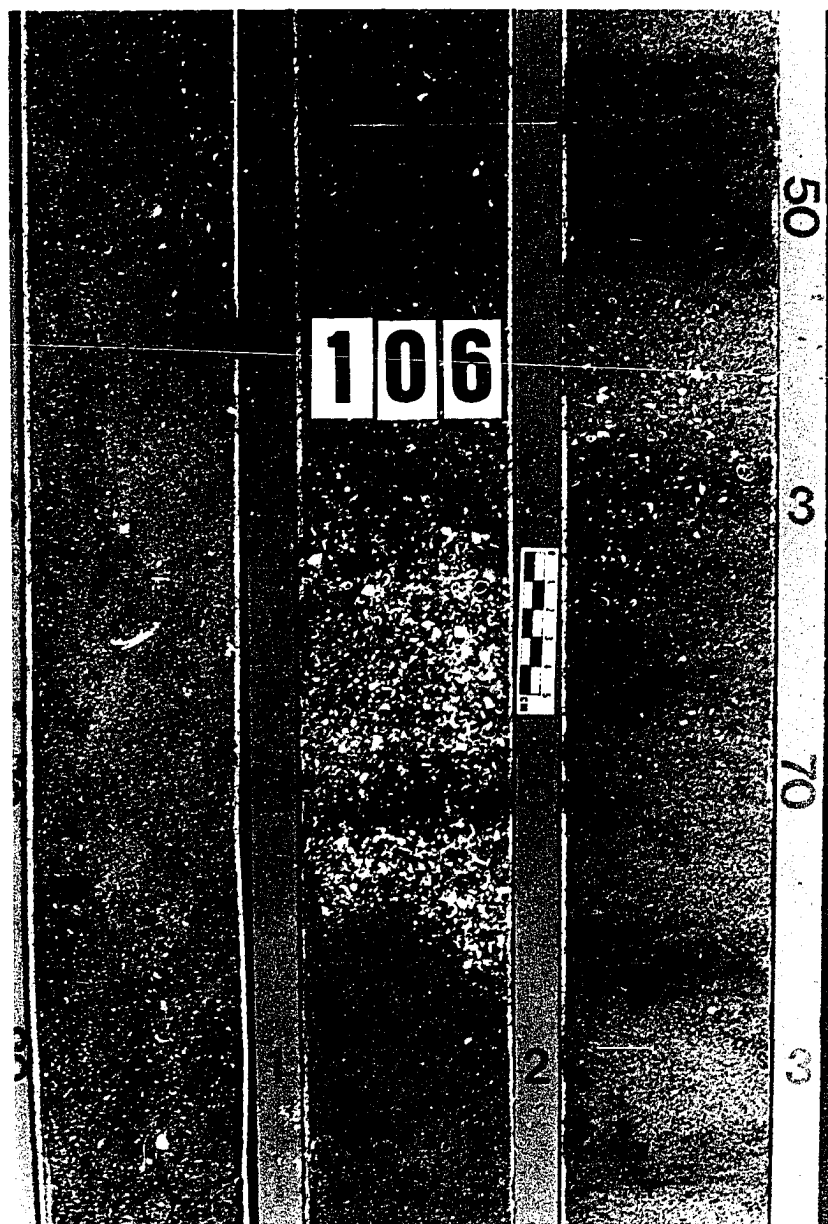


Figure 56. Core Photograph of PAN-6. The upper 4.5 m of this major spit sequence contains alternating intervals of horizontally bedded sands and shells.

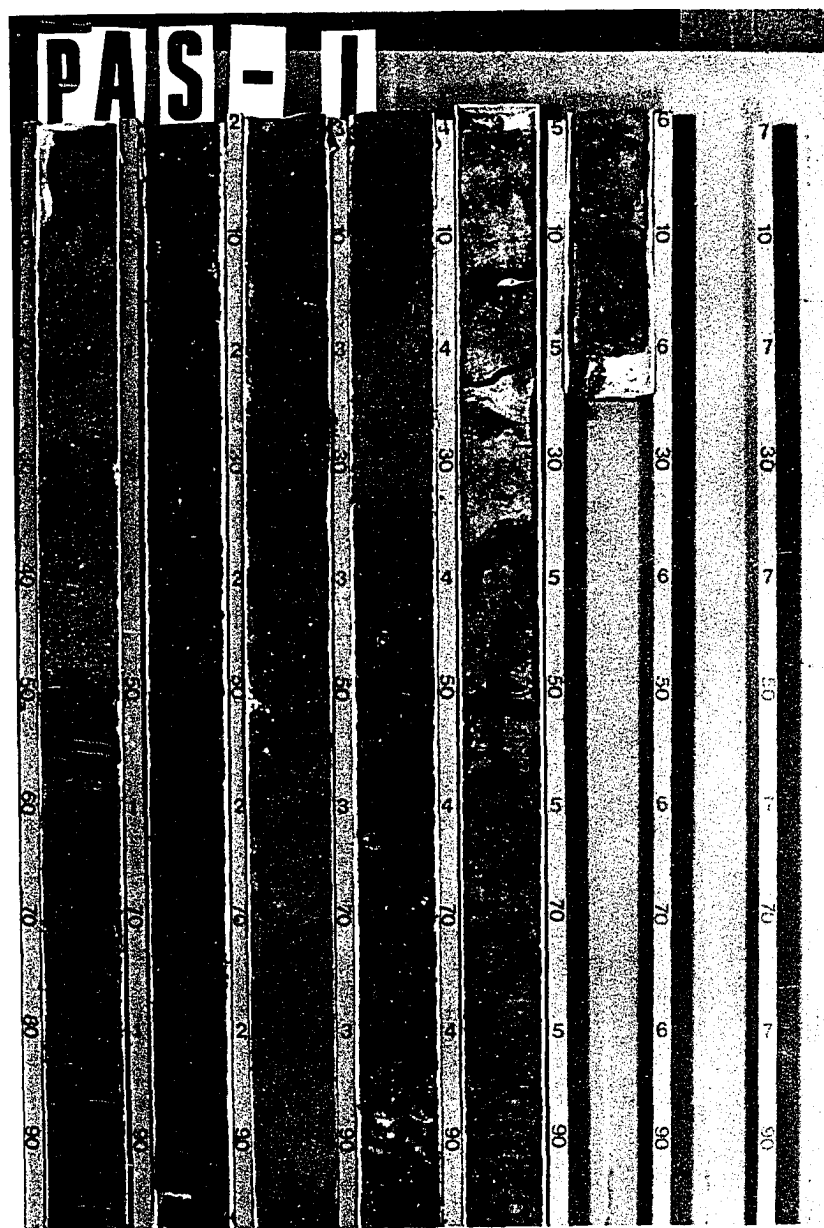


Figure 57. Core Photograph PAS-1. The sharp erosional contact between lower finer grained lithologies and the sandier spit (interval 1.20 m) is commonplace in this suite of cores. The burrowed sandy units between 1.20m and 0.5m probably represent the subtidal spit platform.

Grand Terre is a little over half a meter making it subject to frequent wave overwash and complete submergence during minor storm surges.

The eastern recurve spit of Grande Terre island is presently impinging upon Pass Abel partially filling its western channel margin (Figure 54). This is the only Barataria shoreline example of barrier sediments spilling directly into an inlet channel. Subsurface examples of the barrier lithofacies in these cores are rare (Figure 55).

Lithofacies Description: Core PAN-6 has over 4 m of horizontally layered, alternating beds of shells and sands (Figure 56) where Grand Terre barrier sands are filling the Pass Abel channel. Other cores taken through Grand Terre spit show considerably thinner lithofacies (<2 m) with similar attributes ; horizontal to slightly angular shelly sandy beds with infrequent Ophiomorpha type burrows (Figure 57). Along Grande Terre tabular bedding is observed surficially at the subaerial spit margin. By and large, this facies exhibits coarsening upward sandy shelly units based by bay, marsh, or channel fill units.

Generally, the sandy-spit unit contacts sharply with finer underlying units that grade from burrowed sands to slightly coarser sands with increased shell content (Figure 55). Spit facies exhibit characteristics nearly identical

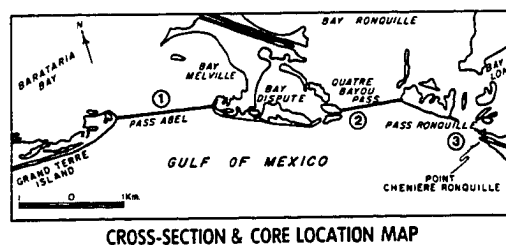
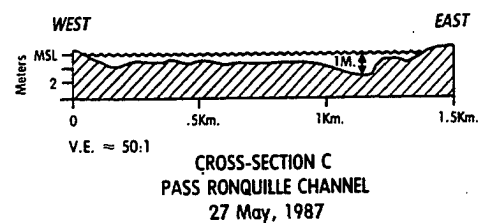
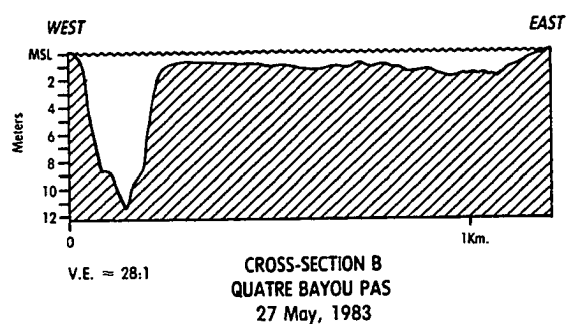
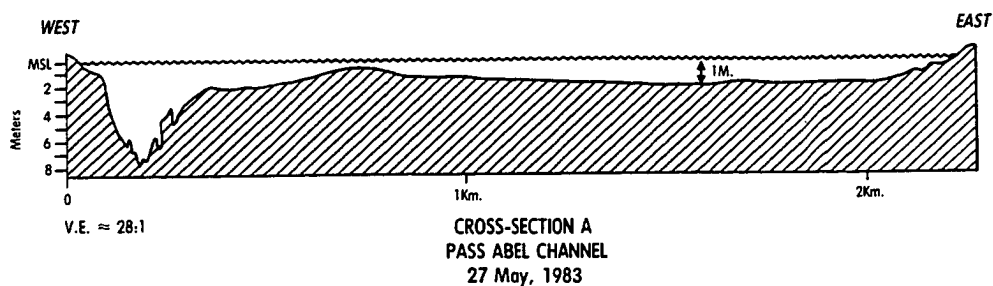


Figure 58. Bathymetric profiles across the eastern Barataria inlets. Both Pass Abel and Quatre Bayou Pass have narrow deep thalwegs on their western side. The majority of the pass throat is dominated by a shallow platform.

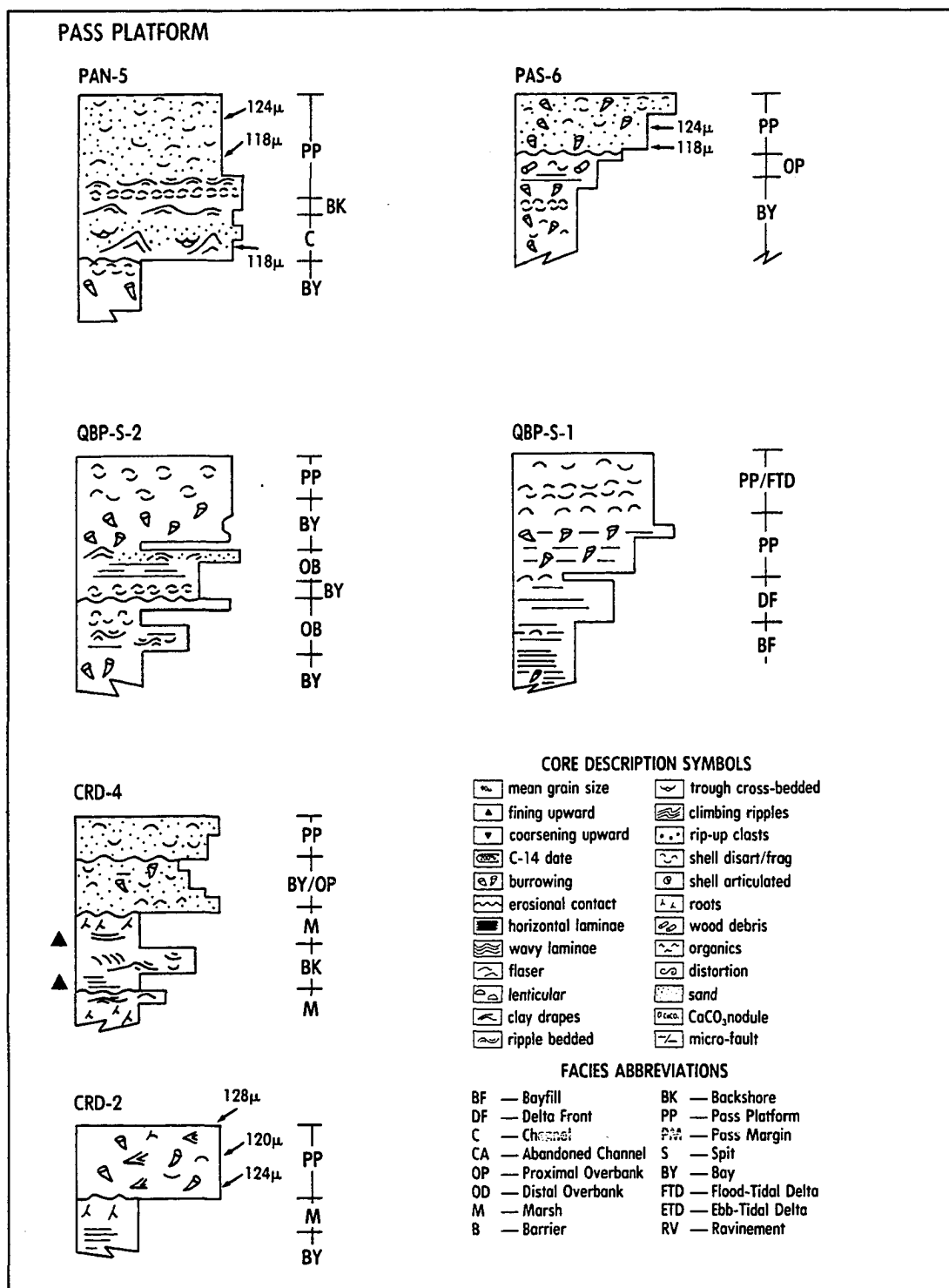


Figure 59. Examples of pass platform sequences described in the Barataria cores.



Figure 60. Core photograph CRD-4. The pass platform sands are only 0.4 m thick, lying over burrowed, bay clays.

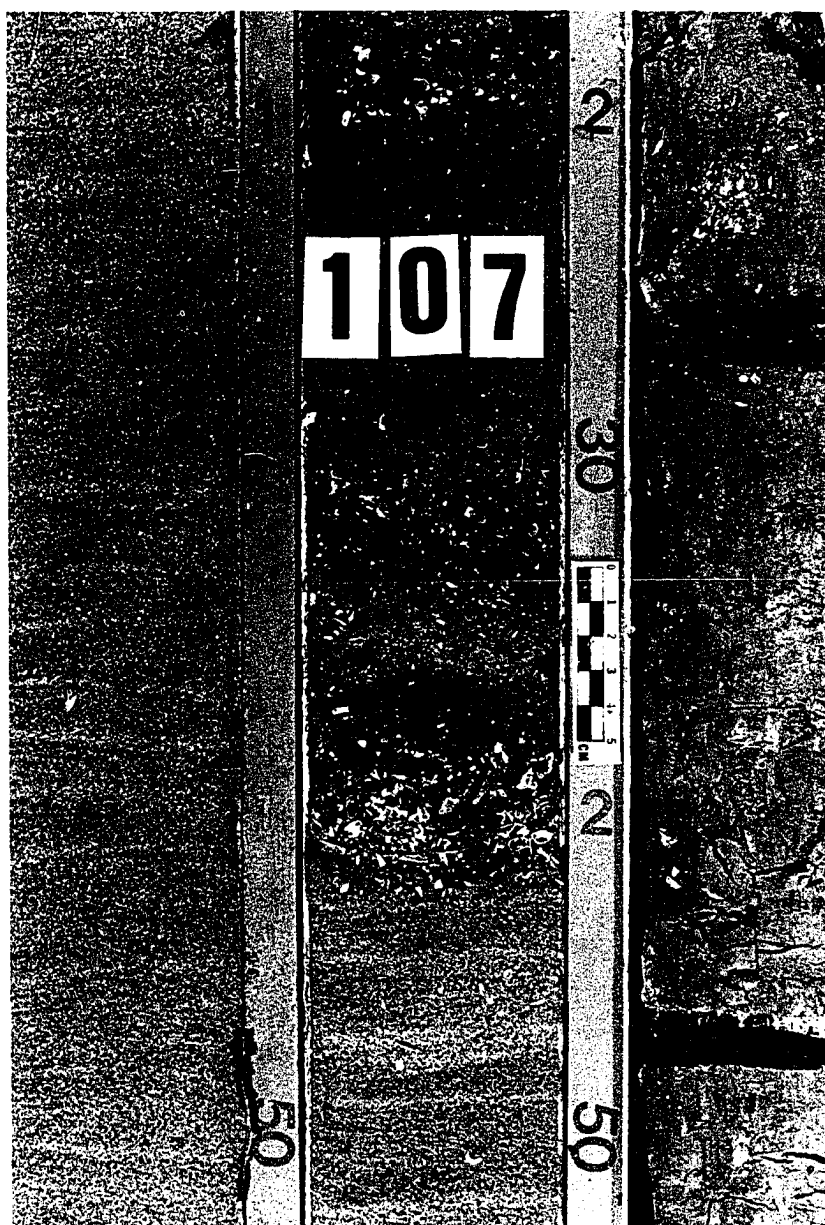


Figure 61. Core photograph PAN-5; interval 1.55 - 1.20 m. Horizontally bedded sands and shells are common attributes of the platform sands.

to those observed on the lower portion of the barrier and pass platform lithofacies, including gently dipping to horizontal bedding with ripples and abundant shell layers. The spit thickness averages less than a meter, except where it is filling the west side of Pass Abel channel (4.50 m).

Pass Platform

Geomorphology: The pass platform is defined as the subtidal, shallow (<1 m deep), flat portion of the inlet throat that lies adjacent to the deep narrow channels. This feature is seen in both Quatre Bayou Pass and Pass Abel (Figure 58). In Pass Ronquille the entire throat is shallow and considered a platform. Examples of the pass platform lithofacies are presented diagrammatically in Figure 59.

Facies Description: This pass component is a coarsening-upward sandy unit, ranging in thicknesses from 0.4 to 2.0 meters (Figures 60 and 61). The platform sands overlie burrowed bay muds. The contact between the sands and muds is usually sharp. The lower portion of the pass platform is burrowed with shells (Figure 59). Burrowing decreases while shell content and sand size increases toward the top of this lithofacies. Thin beds of horizontally bedded, rippled sands and shells were prevalent (Figure 61) higher in the unit. The capping sand sizes had a mean grain size of 125 μ compared to 120 μ below (Figure 59). The pass platform is



Figure 62. Oblique aerial photograph of Pass Ronquille. The sandy flood tidal delta lobes are formed by the combined flood currents and Gulf generated waves. The Gulf of Mexico is to the top of the picture.

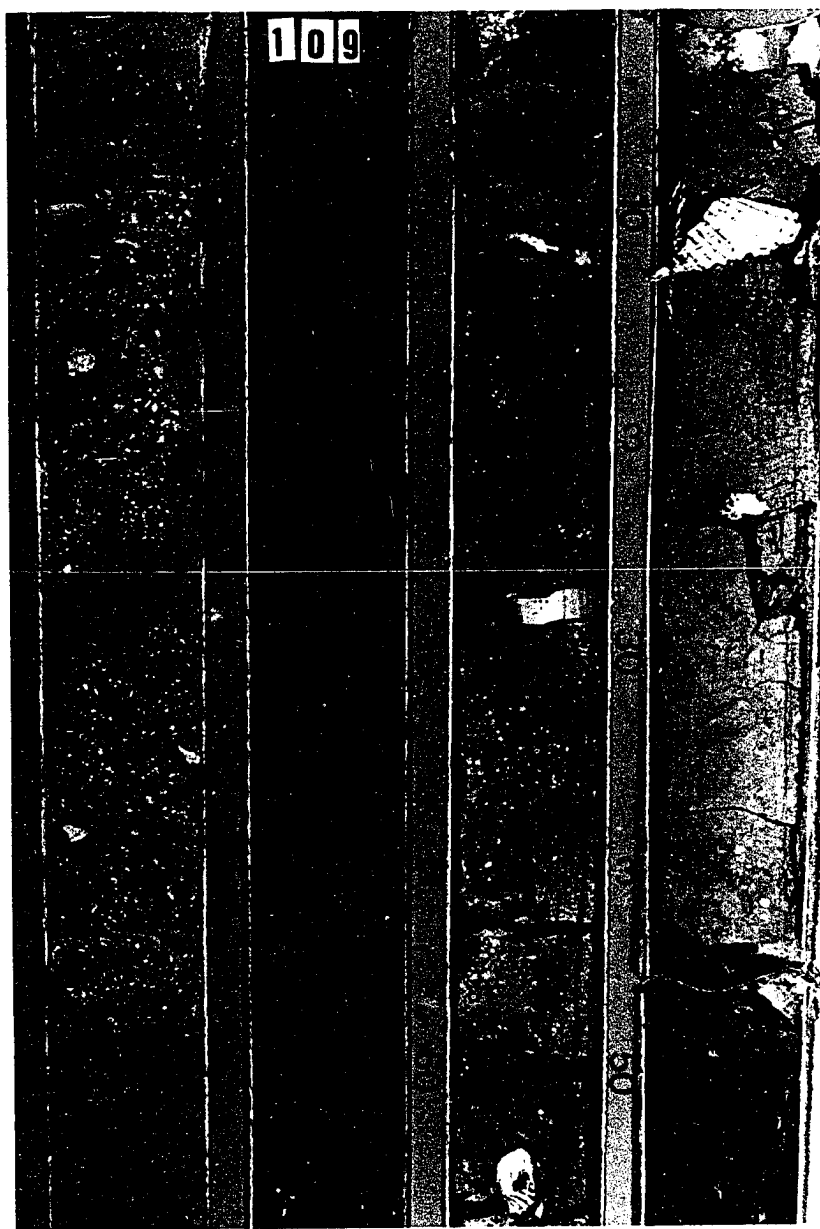


Figure 63. Core photograph PAN-3; interval 0.3 - 0 m. The upward increase in shell size and content is typical of the flood tidal delta unit.

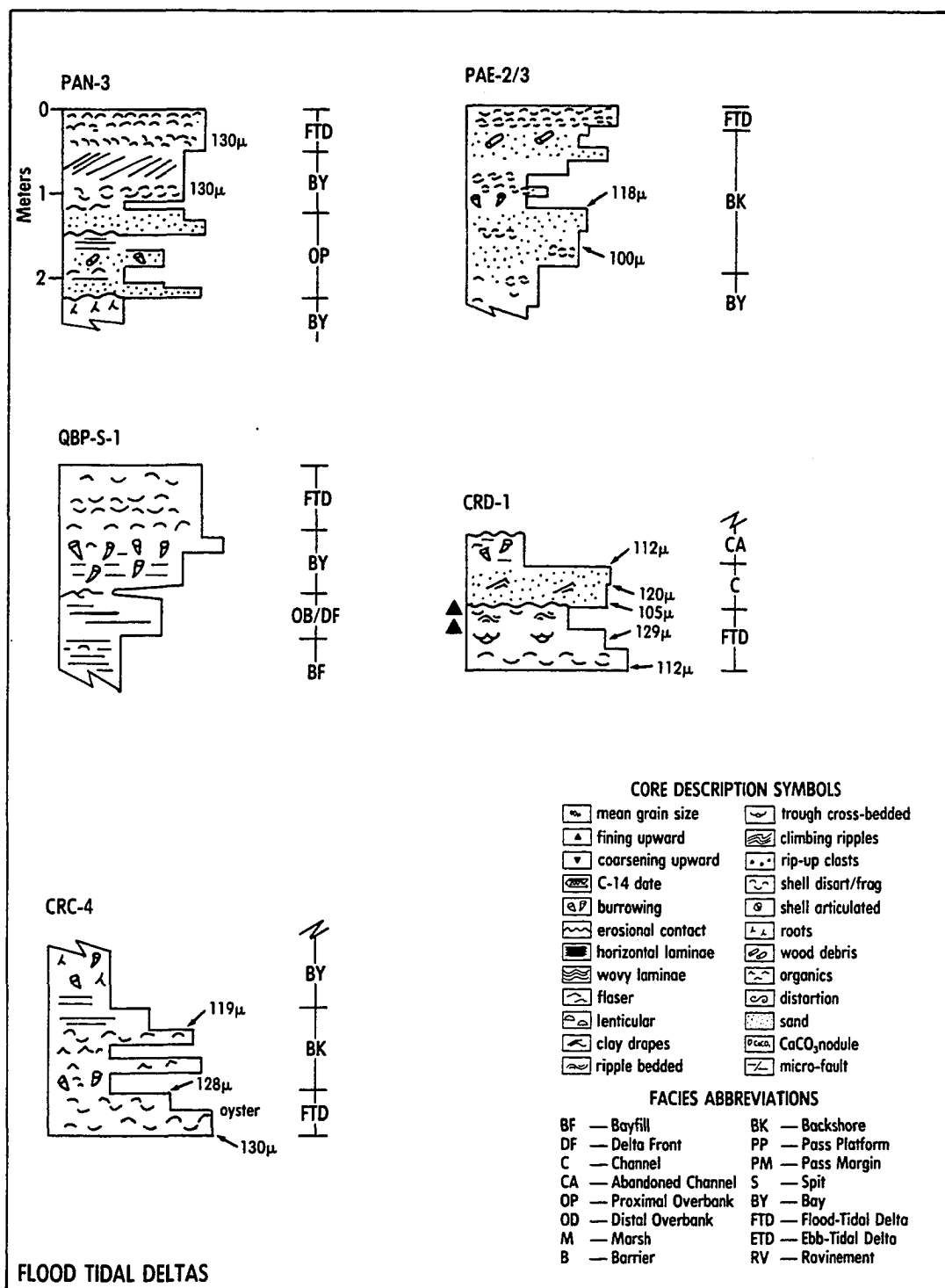


Figure 64. Diagrammatic examples of flood tidal delta sequences.

the foundation for flood tidal deltas in Pass Abel and Quatre Bayou Pass.

Flood-tidal delta

Geomorphology: Flood-tidal deltas are sandy, inlet-associated deposits formed on the landward side of the inlet throat (Hayes, 1975). Flood tidal deltas such as that formed in Pass Ronquille (Figure 62) are common to wave-dominated shorelines (Hayes, 1975). The flood tidal delta in Pass Abel is offset to the east of the inlet channel (Figure 52) and covers most of Bay Melville's bottom. In Quatre Bayou Pass the flood tidal delta is entirely subtidal and differentiated from surrounding environments by lithology (Howard, 1983).

Facies Description: Sand size in the Pass Abel flood tidal delta is relatively constant (130 μ), however, there is a significant increase in shell content towards the crest (Figure 63). This characteristic is consistent in all flood tidal deltas (Figure 64). The average flood tidal delta thickness is 63 cm. The basal portion of the flood delta usually capped a burrowed sand with minimal shell content.

A unit in the subsurface of Pass Ronquille was identified as a flood tidal delta by its intrinsic characteristics, in addition to striking sedimentologic similarities with the present Pass Abel flood tidal delta. Perhaps coincidentally, core PAN-4 (which sampled through

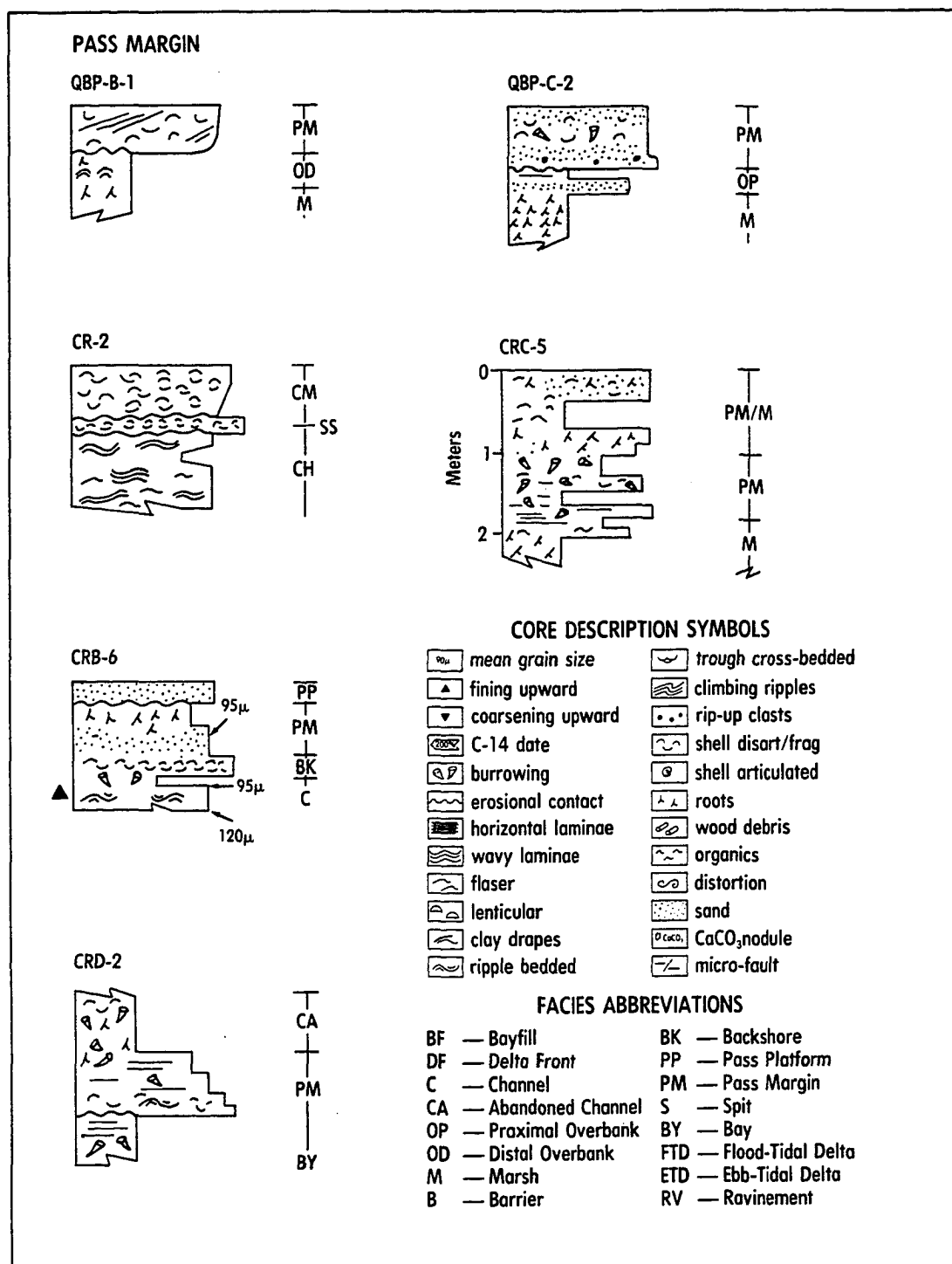


Figure 65. Diagrammatic examples of channel margins.

the crest of Pass Abel's flood tidal delta (Figure 52) and core CRC-4 (Figure 64), had identical mean grain sizes of and both exhibited slightly improved sorting characteristics. The categorization of depositional environments by statistical parameters of the sediments alone has been attempted (Visher, 1969) but is not wholly reliable as the sole means of characterization (Pettijohn, 1975). The base of core CRC-4 was sandy with imbedded Crassostrea sp. fragments. These characteristics are consistent with those described at the surface in core PAN-4, further supporting the interpretation of the buried facies in core CRC-4 as a flood tidal delta.

Channel Margin

Geomorphology: Channel margins include the intertidal to supratidal fringes of the pass openings, levees and marsh banks that channelize tidal flow within the interdistributary bays (Figure 52). Examples of these are found on either side of the three passes. They include the west boundary of Quatre Bayou pass channel, relict Cat Bayou levee on the east, and borders of various feeder channels to Bay Long.

Facies Description Lithologically they are comprised of homogeneous quartzose sands with a moderate shell content and some burrowing (Figure 65). Spartina roots are found in



Figure 66. Core photograph CRB-6. The sharp contact at 0.5 m suggests that the channel margin floods on occasion causing a temporary widening of the pass.

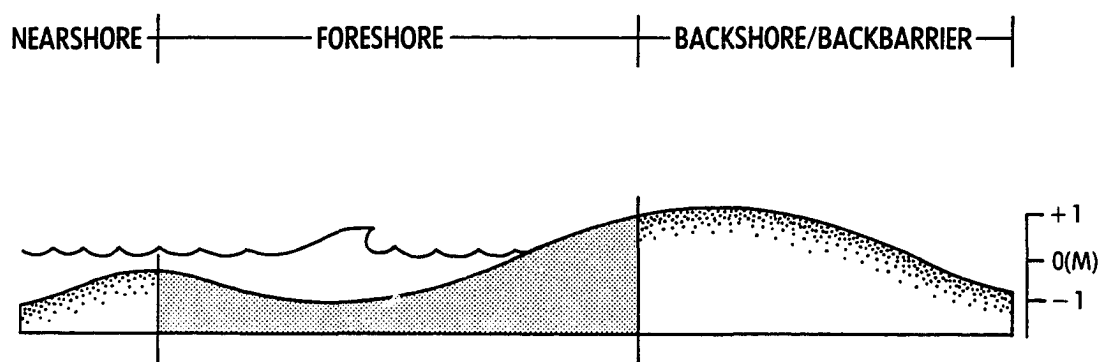


Figure 67. Diagram of barrier shoreline components. The barrier/beach is located in the foreshore zone between the berm crest and the low-tide terrace.

those channel margin areas less frequently submerged. Channel margins are, on the average, 1.10 m thick. The basal contact of most channel margins are sharp and erosional, oftentimes lying over bay or marsh deposits. When the channel margin becomes completely subtidal that unit is capped by coarser sands of the pass platform. An example of this sequence was described in core CRB-6 (Figure 66). The shells and quartzose content of the sands differentiate pass margin overbank deposits from distributary related overbank deposits.

BARRIER LITHOFACIES

Barrier Gemorphology: The accumulation of sands along the Mississippi River delta plain shoreline occurs where flanking spits grow across the front of interdistributary bays (Penland and Boyd, 1981) or barrier sands migrate landward through overwash processes (Andrews, 1970). Morphologically, the barrier units are located between the berm crest and nearshore bars (Figure 67).

The eastern Barataria barriers, assigned by the Louisiana Geological Survey to the Plaquemines Barrier Shoreline (Nakashima, 1988) are narrow (25 m) extremely low profile (Morton and Nummedal, 1982) barriers representing the fastest eroding shoreline in Louisiana (Nakashima, 1988). Barrier elevations east of the Grande Terre spit are little more than 1.0 m above mean sea level. Vertical accretion

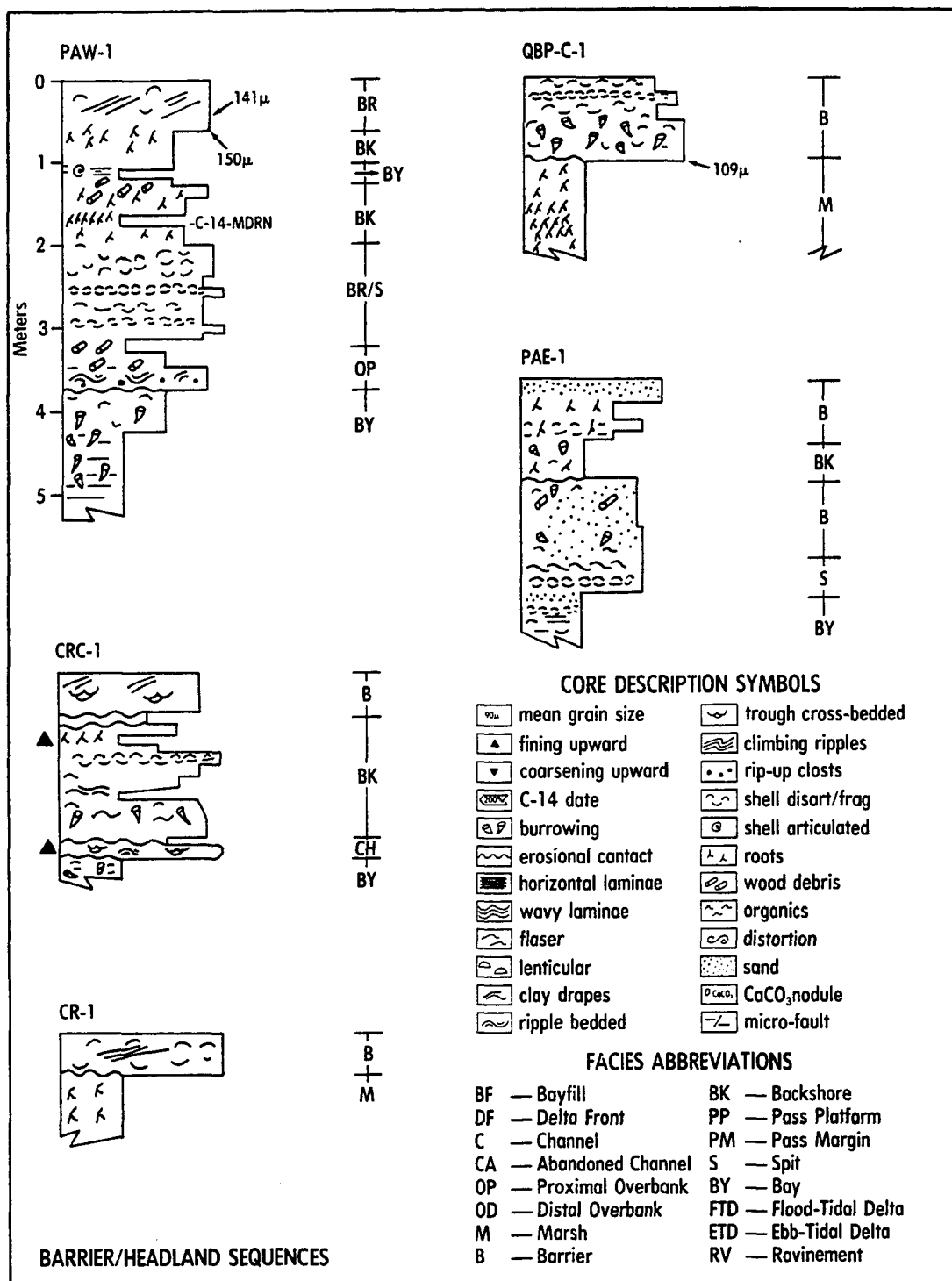


Figure 68. Diagram of barrier sequences described in the Barataria suite of cores.

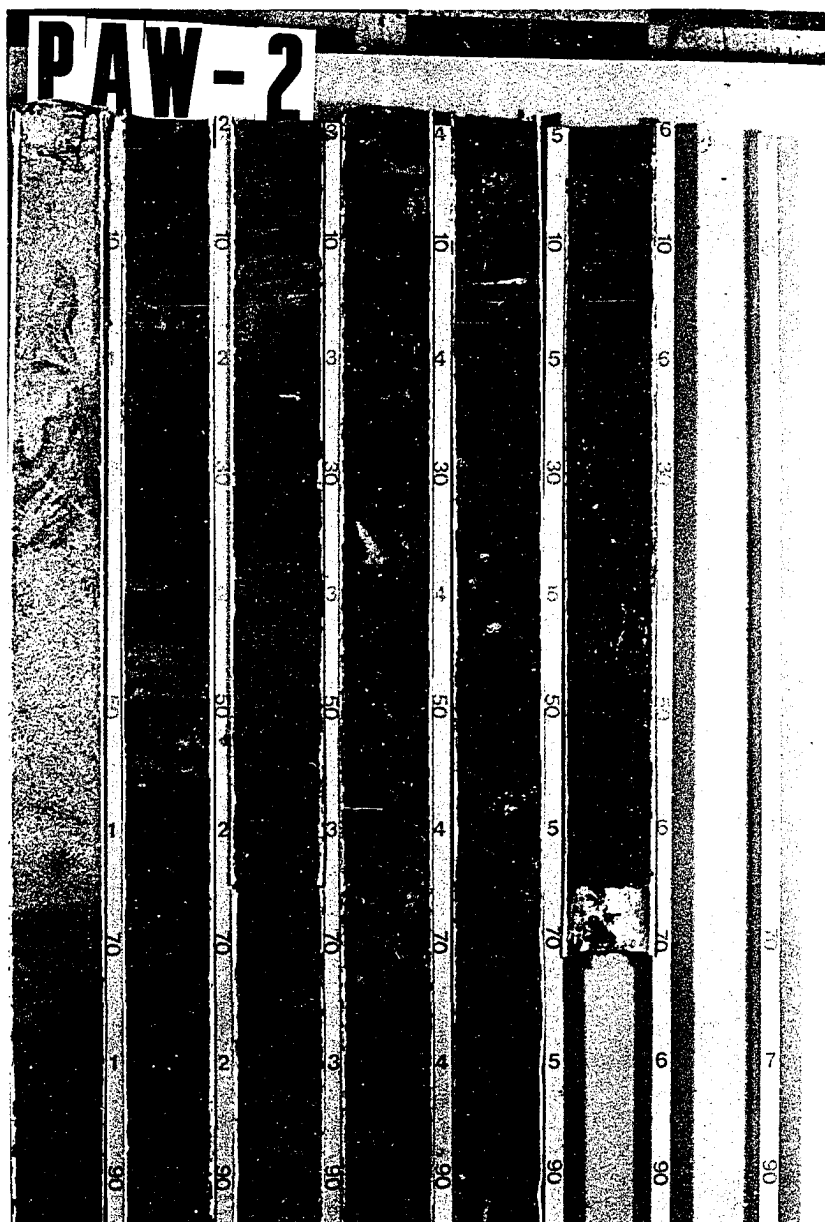


Figure 69. Core photograph PAW-2. Note the seventy centimeter veneer of sand which has buried a vegetated backshore unit. The sandy unit contains a large vertical burrow.



Figure 70. Core photograph PAW-1. The lower barrier unit 3.70 m to 1.70 m lies below a backbarrier marsh (1.7 to 0.7 m), which is capped by the present (70 - 0 cm) beach of Grand Terre. Note the humic staining that has stained the location of a dissolved root (2.2 to 2.0 m).

on the barriers is limited to washovers and eolian deposition is insignificant (Nakashima, 1988).

Description: Barataria barriers frequently cover fine-grained backbarrier/bay units or the rooted marsh environments of an eroding headland (Figure 68). The fragile nature of the Barataria barrier environment is accentuated by the thin veneer of sand within these sequences. The east beach on Grande Terre is only 70 cm thick at the berm crest (Figure 69). This barrier lies atop a backbarrier/low-marsh unit.

Core PAW-1 (Figure 70) exhibits stacked barrier sequences. The lower barrier was capped by a finer backbarrier environment. Through time the initial barrier eroded and its sands have been cannibalized and transported landward to form the beaches presently observed. The lower sandy barrier unit is significantly thicker (1.68 m) than any observed in the present subaerial beaches. Humic staining (Figure 70) (Moslow, 1980) in the upper portion of this barrier units suggests that vegetation had been established, probably in the dune like setting of a relatively "high profile barrier".

Barrier sands contain low angle to horizontal bedding similar to those seen in the Isles Dernieres by Neese (1984). Primary bedding features in the barriers included cross bedded ripples (Figure 69). The sands contain layers of disarticulated, imbricated shells indicative of storm,

washover deposits and, infrequently, thin layers of roots. In the higher profile (relatively speaking) Isles Dernieres physical structure of the barrier was frequently destroyed by extensive rooting and burrowing (Neese, 1984). Floral and faunal activity of this extent is probably limited to the supratidal beach ridges. The low-profile barriers along the Barataria shoreline are generally not conducive to higher elevation dune environments. Where vegetation is present it is only sparse. Burrowing is also fairly common in the Barataria beach units (Figure 68). Only one example of a strand plain ridge was sampled in the subsurface (Figure 71). Statistical parameters of sands sampled from the Barataria Barriers are included in Appendix II.

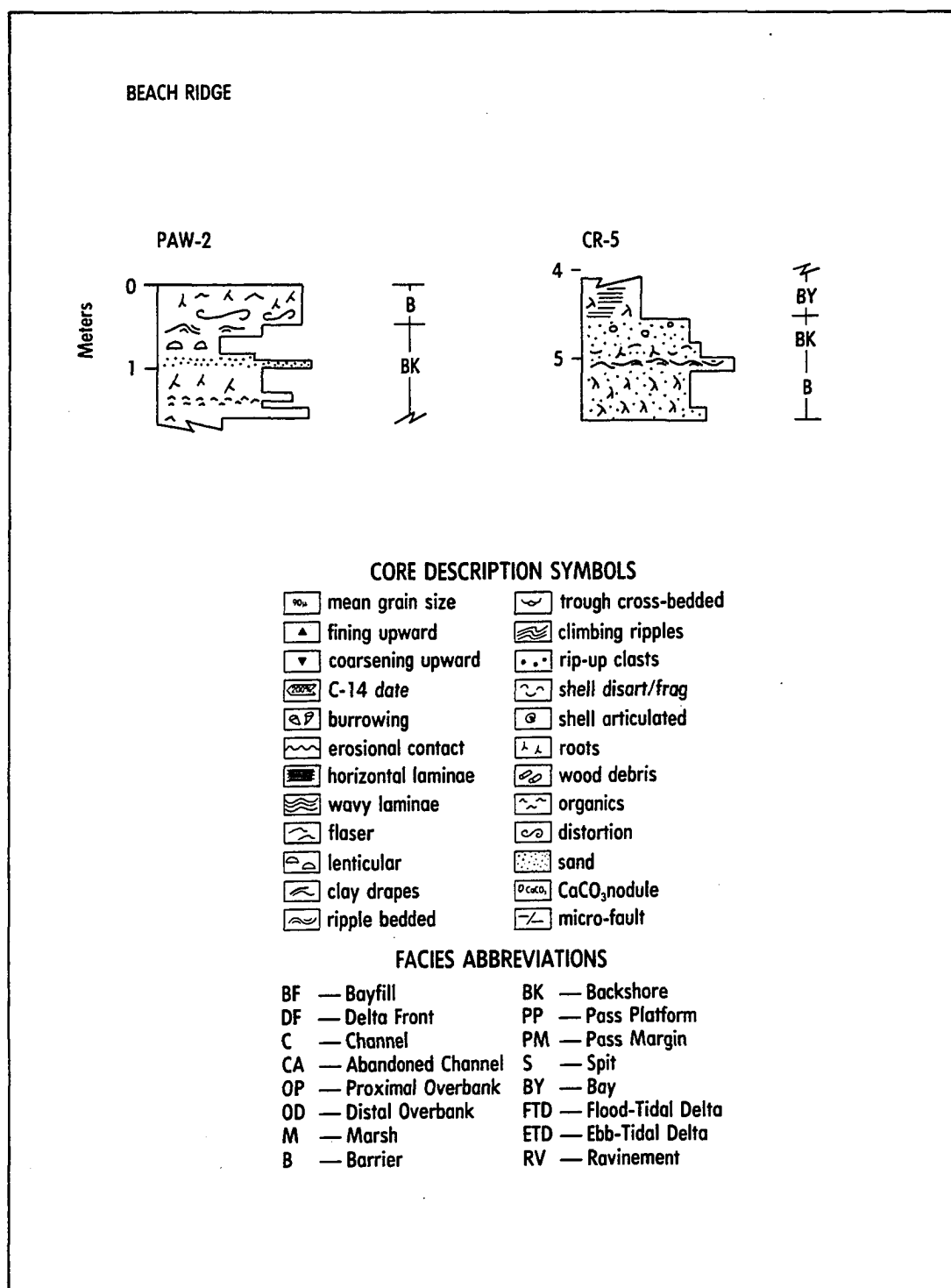


Figure 71. Core logs of barrier sections in cores PAW-2 and CR-5. The spartina rooted sands in core CR-5 were recovered at a depth of -5.0 m MSL. This is the deepest example of a beach ridge recovered in this suite of cores.

4. OFFSHORE STRATIGRAPHY OF THE BARATARIA REGION

INTRODUCTION

This chapter presents cross sections constructed with core descriptions provided by the Louisiana Geological Survey. The locations of these cores are shown in Figure 9. The transects are broken down into parasequences (Van Wagoner et al., 1987) labeled with abbreviations of the delta lobe that Chapter 8 will identify it as. For example, parasequence BB described in the Results section is a product of the Bayou Blue delta lobe. The postfix Re or Tr identifies the parasequence as being part of the regressive (Re) or transgressive (Tr) phase of the respective delta lobe. This convention will facilitate the reader's transition from the results section to the discussion of delta lobe sequence and chronology.

Transect Offshore A - A'

This line of cores was taken approximately 3 km seaward of the Barataria shoreline in 7 m of water. These cores sampled to subsurface depths of more than 20 m below sea level. The spacing between cores ranges from one to two kilometers.

Transect A-A' / Parasequence F-Regression (Re)

Description: Bayfill muds coarsen to delta front sands and then active channel facies between -20 and -15 m in cores 37 and 38 (Figure 72). Cores 37, 38 and 39 also contain

CROSS SECTION A-A'

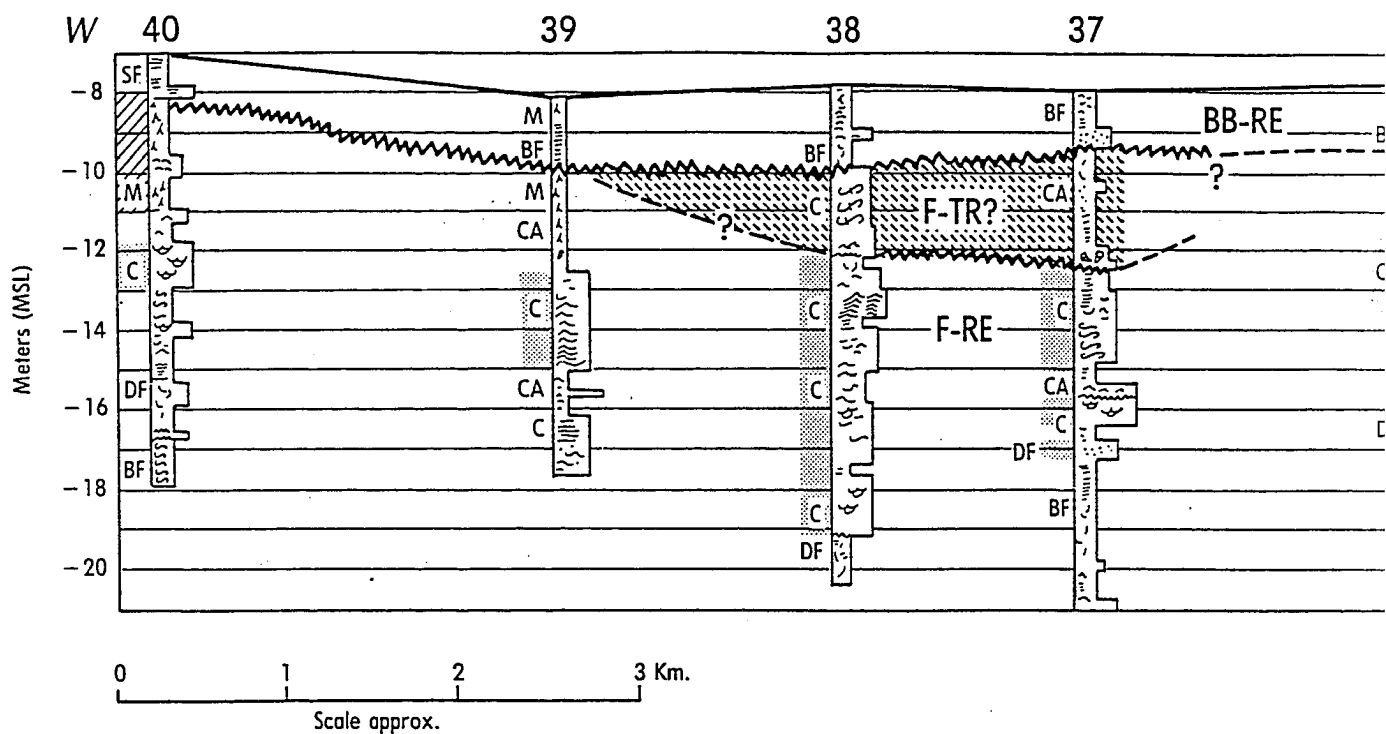
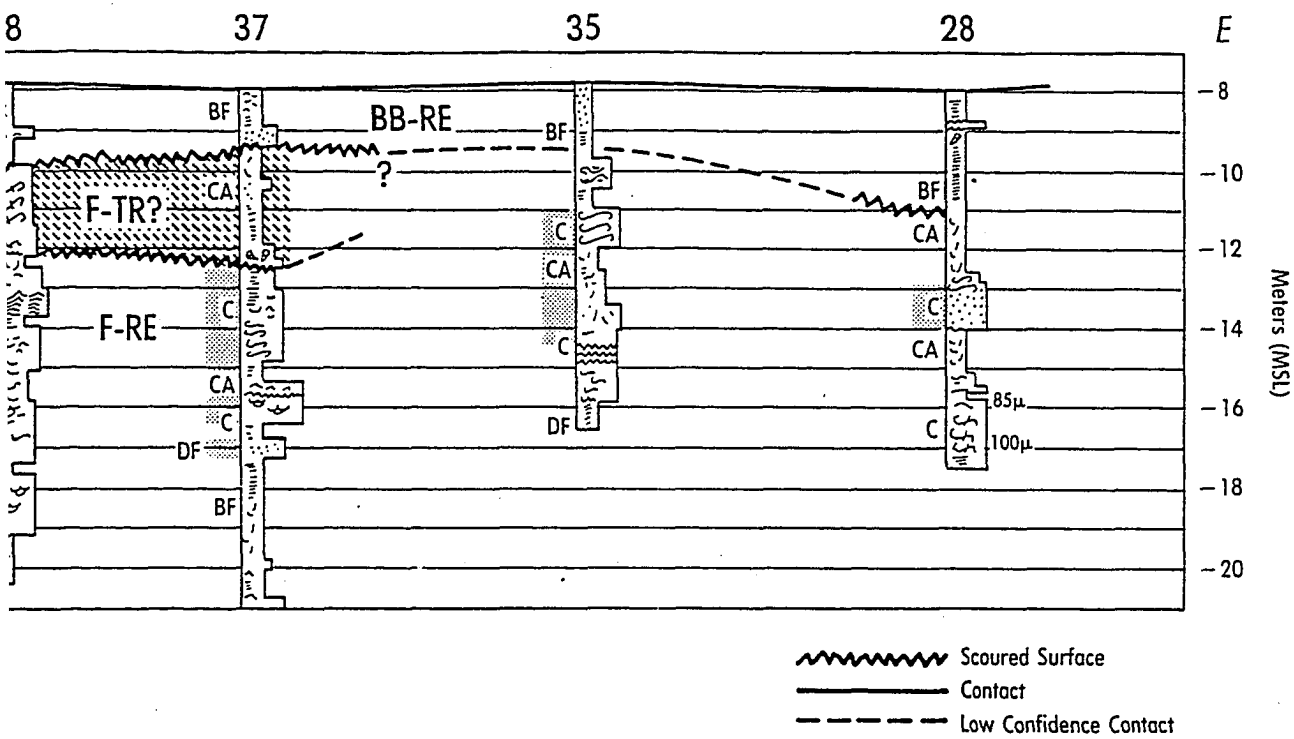


Figure 72. Transect A-A'. Periods of transgression are not well preserved and are defined primarily as contacts. Parasequence F-Tr is proposed to be the transgressive component of the des Familles delta lobe.



s of transgression are not
rimarily as contacts.
be the transgressive
lta lobe.

extensive active channel fills between -15 and -11 meters (Figure 72). Channel sand thickness ranges between two and three meters. Cores 40 and 28 contain thinner (<1 m) channel-like units that lie slightly higher than the larger channel deposits. Active channel sands were not fully penetrated in cores 28 and 39 so their total thickness could not be measured. Cores 35 and 40 contain muddy lithologies between -17 and -15 m. A truncation or distinct change in facies appears consistently in this cross-section at -15 m (Figure 72). For the most part the lithology above this transition coarsens abruptly and then fines upwards. In cores 39 and 40 sands grade to marsh. Cores to the east of 38 become interdistributary bays between -12 m and -8 m.

Interpretation: Parasequence F-Rg represents the deepest and oldest Barataria delta lobe. The minor channels that are located laterally and slightly higher than the main distributary channels are interpreted to be crevasse splays. The contact at -15 m may be the result of a hiatus in sedimentation caused by a temporary switch in the delta lobe depocenter. There is no evidence that would suggest that the truncation at -15m is a ravinement surface of any kind.

Transect A-A' : Parasequence F-Transgressive (F-Tr)

Description: There is no obvious evidence of a shoreline

transgression following the abandonment of delta lobe F-Re (Figure 72). Indications that a transgression did occur is interpreted from erosive contacts within core 38 and 37 at a depth of -12 m and in cores 40 and 39 between -8 and -9 m (Figure 72). The base of bayfill muds in cores 35 and 28 occurring at depths of -9 and -11 m, respectively, are interpreted as the elevation of a bay ravinement, or flooding surface. The bay ravinement is characterized in core 39 (-10 m) and 28 (-11 m) as the contact between burrowed bay muds (lower) and laminated bayfill clays (upper). Bayfill, laminated clays over delta plain material at -8.2 m in core 40 suggests that this may be a flooded, bay ravinement.

The active channel facies in all cores except 38 show that they were abandoned at the - 12 m level (Figure 72). In core 38 active channel facies of parasequence F-Re grade to a thin stratum of burrowed and laminated clays at -12 m. Above this is a 2 m thick deposit of sandy silts containing deformed ripple-bedding and micro-faults. This unit may be interpreted as channel fill occurring during lobe abandonment or the base of a newer channel that has scoured into the lower distributary. There is no available evidence that can conclusively determine whether this channel cut down into underlying strata. Further, there are no obvious overbank deposits in cores 39 and 37 that can be tied directly to active channel progradation. It is,

however, important to note that the closest cores lie nearly a kilometer to either side. At that distance, overbank deposits would probably not be observed.

Interpretation: There are no obvious transgressive sands separating upper and lower delta lobes that would allow positive identification of F-Tr in this cross section. However, several relatively sharp contacts between the upper and lower regressive sequences suggest that a bay ravinement surface lies at, or near, the eight meter level. It is difficult to confidently draw a ravinement surface through core 38. It either lies at -12 m, below the upper channel unit, or over it at -10.0 m. Seismic reflectors within the channel sampled by core 38 do not exhibit obvious truncations below -9 m (Figure 73). Based upon seismic records the ravinement surface is drawn between -8 and -9 m msl.

The abandoned channel unit in core 38 between -12 and -10 m may be a tidal inlet fill. Tidal channels are the most likely of all features to be preserved during a transgression because they lie below the retreating shoreface (Hubbard and Barwis, 1974). An alternate interpretation is that this unit is the result of scour of an earlier distributary channel caused by a drop in sea level (Van Wagoner et al., 1987). This scenario will be discussed in further detail in a later chapter of this dissertation.

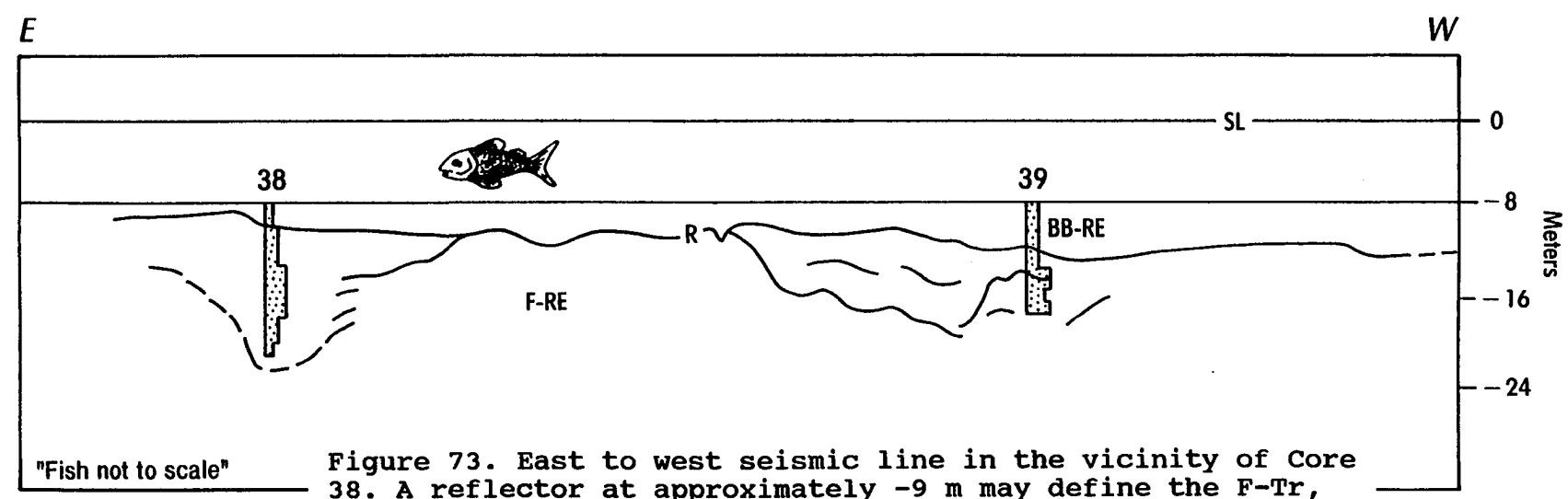
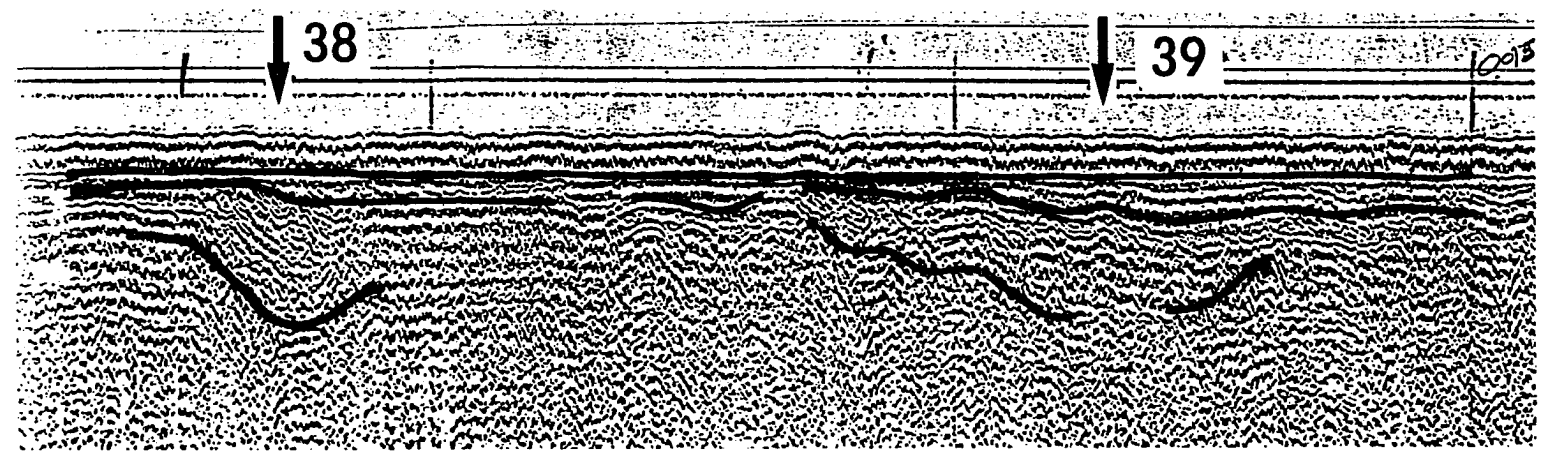


Figure 73. East to west seismic line in the vicinity of Core 38. A reflector at approximately -9 m may define the F-Tr, Families Transgression. Consult figure 9 for data location.

Transect A-A' / Parasequence BB-Re

Description: Parasequence BB-Re lies between parasequence F-Re at -9 m and the sediment/water interface (Figure 72). It is comprised of bayfill facies truncated by the ravinement at the base of the present shoreface. Cores did not sample channel features in BB-Re.

Interpretation: No channel features were identified in BB-Re. This transect cuts across the basal portion of a delta lobe which consists predominantly of bayfill muds and delta front sands. Channel features of parasequence BB-Re have been truncated by the present transgression.

Transect Offshore B-B'

This series of cores was taken approximately 1 kilometer off of the present Barataria shoreline in 3 to 4 m of water (Figure 9). Seven cores define this 8 km strike section.

Transect B-B' / Parasequence F-Re

Description: Parasequence F-Re is located below -9 m and is comprised primarily of fine-grained interdistributary bay (cores 11, 14, 9, 8) and delta plain marsh facies (core 17). The rooted strata in these cores (Figure 74) correlate with similar facies located at identical depths in core 40 (Figure 72).

In core 10 at this level the interval between -15 and

CROSS SECTION B-B'

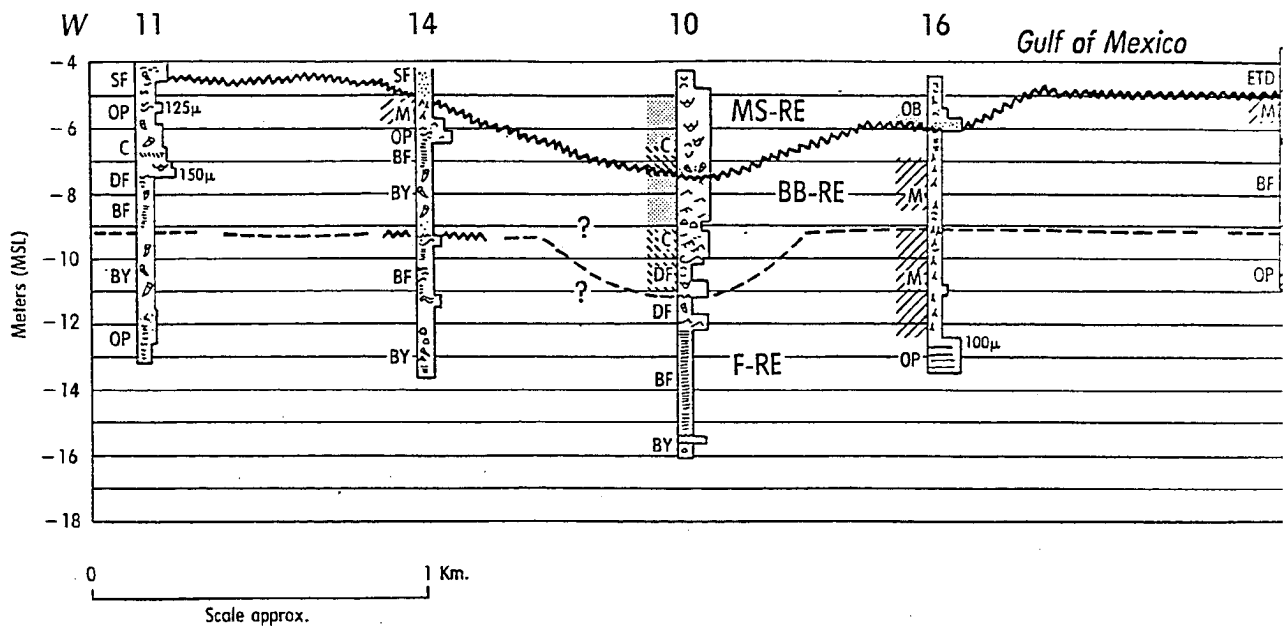
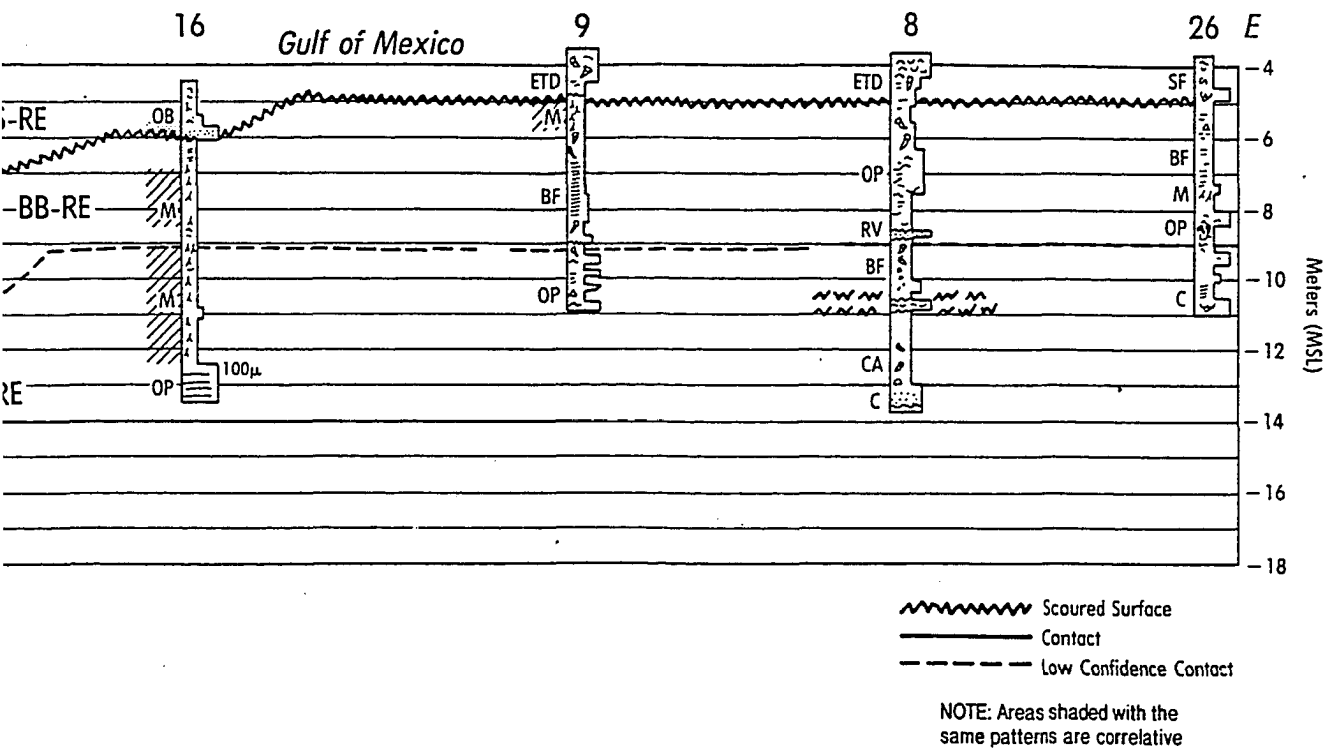


Figure 74. Transect B-B'. This cross-section exhibits three packets of regressive sediments separated by contacts that are proposed to represent transgressive events.



cross-section exhibits three
separated by contacts that
gressive events.

-12 m contains laminated clays interpreted as bay fill from an advancing delta lobe. The laminated muds coarsen to delta front sandy silts at 11 m before being truncated by a channel cutting from above.

Interpretation: The collective lithofacies in parasequence F-Re (Figure 74) represent a prograded delta lobe.

Transect A-A' contains channel sands several meters thick within this depth interval (Figure 72). In Transect B-B' channels associated with the offshore F-Re interval were not sampled.

Transect B-B' / Parasequence F-Tr

Description: Stratigraphic evidence of the transgressive component of F-Re is not obvious in this transect. Its location is interpreted from vertical facies change and erosional surfaces identified in some cores. Core 8, at -11 m, contains a thin stratum of Mulinia sp. with upper and lower erosive contacts. Mulinia sp. is a brackish water bivalve tolerant of a salinity range between 2 and 15 ppt (Tarver and Dugas, 1972). This and a scoured surface in cores 8 and 26 at -9.3 m, are the only evidence of a transgression occurring at this level.

In Core 10 identification of the ravinement is also difficult. Possible locations of this surface are at -10.5 m where Mulinia sp. are encased in muds, or within the lithologically finer interval between two active channel deposits at -9.2 m. The base of the channel sampled by

core 10 is traceable on seismic records to depths of -16 m (Figure 75). It is possible that this channel facies lies within an older distributary position.

In core 9 there is no clear evidence of a ravinement surface. One is projected to occur near -9 m between burrowed bay muds and laminated bayfill of the overlying delta progradation.

Interpretation: There is little evidence, if any, suggesting that shoreface actually passed this shore position. Based on the subtle transition between upper and lower facies and a lack of transgressive sands, a more plausible interpretation is that this is a bay ravinement/marine flooding surface.

Transect B-B' : Parasequence BB-Re

Description: An active channel facies in core 10, between -10 and -5 m, appears to be continuous. However, a thin stratum of burrowed sands has been used to separate the facies into two upper and lower channel units. Seismic data shows another channel lying to the east between -8 and -4 m in the vicinity of core 9 (Figure 76). Other cores in BB-Re contained bayfill, overbank and interdistributary facies.

Interpretation: Parasequence BB-Re is part of a prograding delta lobe. The large channel unit penetrated by core 10 and revealed by seismic data appears to represent one of

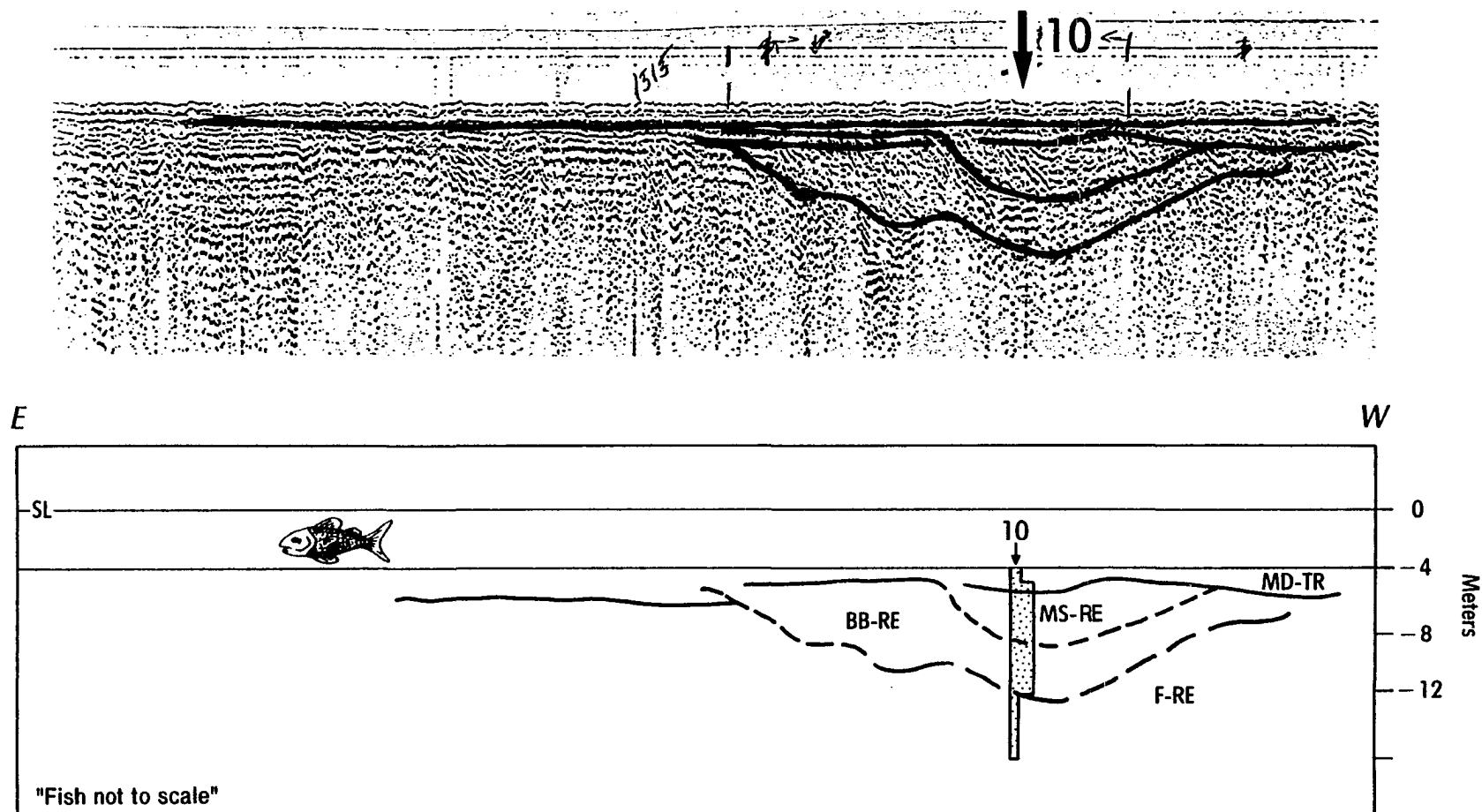


Figure 75. East to West Seismic records that show a channel feature in the vicinity of core 10. A smaller channel appears to be "piggy-backed" within a deeper, larger channel. BB-Tr may represent a tidal inlet deposit. Consult figure 9 for data location.

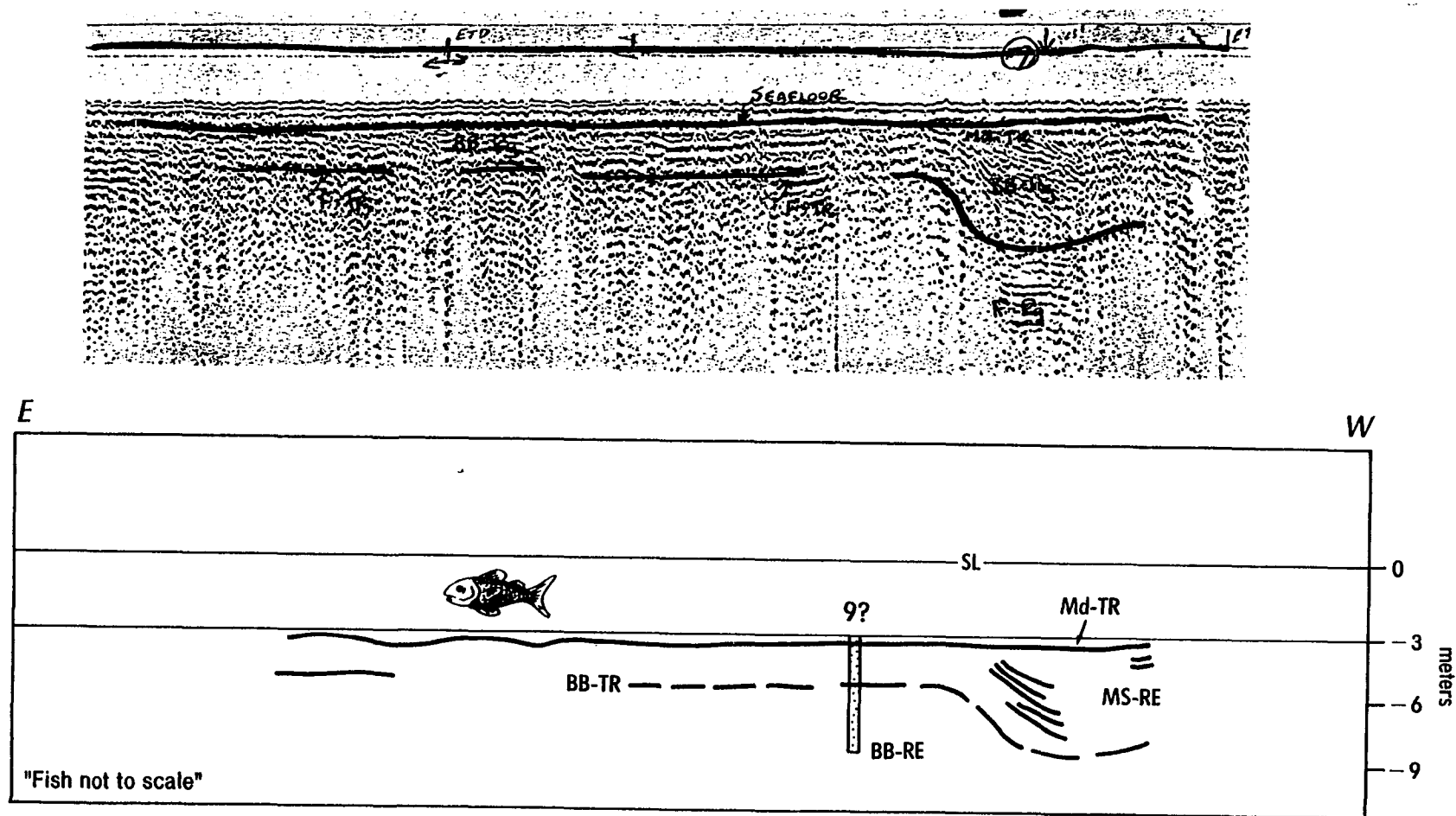


Figure 76. East to West Seismic records show a channel feature in the vicinity of core 9. The exact position of core 9 is not known. Consult figure 9 for data location.

that delta lobe's main distributaries.

Transect B-B': Parasequence BB-Tr

Description: In cores 14 16, and 9 at approximately -4.5 m, delta plain marsh is overlain by shelf muds and the modern ebb tidal delta. Above the contact on the west side of this transect, sand-filled vertical burrows and small Mulinia sp. and Rangia sp. valves are present in a muddy matrix. A scoured surface at -7.5 m in core 10 is overlain by burrowed sands that contain intraclasts.

Interpretation: The contact lying generally at the -5 m elevation defines the transgressive phase of the BB-Re delta lobe abandonment. The base of the channel in core 10 at -7.5 m is at a considerably lower elevation than the inferred ravinement surface identified in adjacent cores. This is interpreted to be the base of a channel that scoured downward into the underlying strata. Channel deepening may occur as a result of increased discharge or a lowering of sea level (Van Wagoner et al., 1987). On the other hand, the submergence of delta plain marsh in cores 9, 14 and 16 suggests that sea level rose during later stages in the BB delta cycle.

Transect B-B' : Parasequence Ms-Re

In all cores, except 14, disarticulated Mulinia sp. and Rangia sp. and Crassostrea virginica shells and shell

fragments are noted near the sediment/water interface. In addition to the increase in shell content, in cores 8 and 9 the lithology coarsens. In core 10 (-7.5 m) the three or so meters of active channel sands contain moderate concentrations of shell debris. The sands were classified as quartzose.

Interpretation: Parasequence Ms-Re defines a post BB-Re delta progradation. It is difficult to determine from the core data whether this parasequence represents the delta progradation, the retrogradational component of the abandoned headland, or the transgressive phase of the abandoned delta lobe. The faunal and mineralogic contents of the channel sands of core 10 suggest that it may be inlet fill.

In two cores (14 and 9) marsh are buried beneath bay muds that contain brackish fauna. These were probably interdistributary bay areas. In cores 8 and 9 the surficial shell rich sands represent the ebb-tidal delta of Quatre Bayou Pass. This parasequence is considered part of the present shoreline transgression., occurring as a result of a recent rise in sea level.

Transect Offshore Dip C-C'

This transect runs normal to the Barataria shoreline between 3 and 9 m of water (Figure 77). Core 2, the seaward most core in this transect, is positioned approximately 6 km seaward of the present

CROSS SECTION C-C'

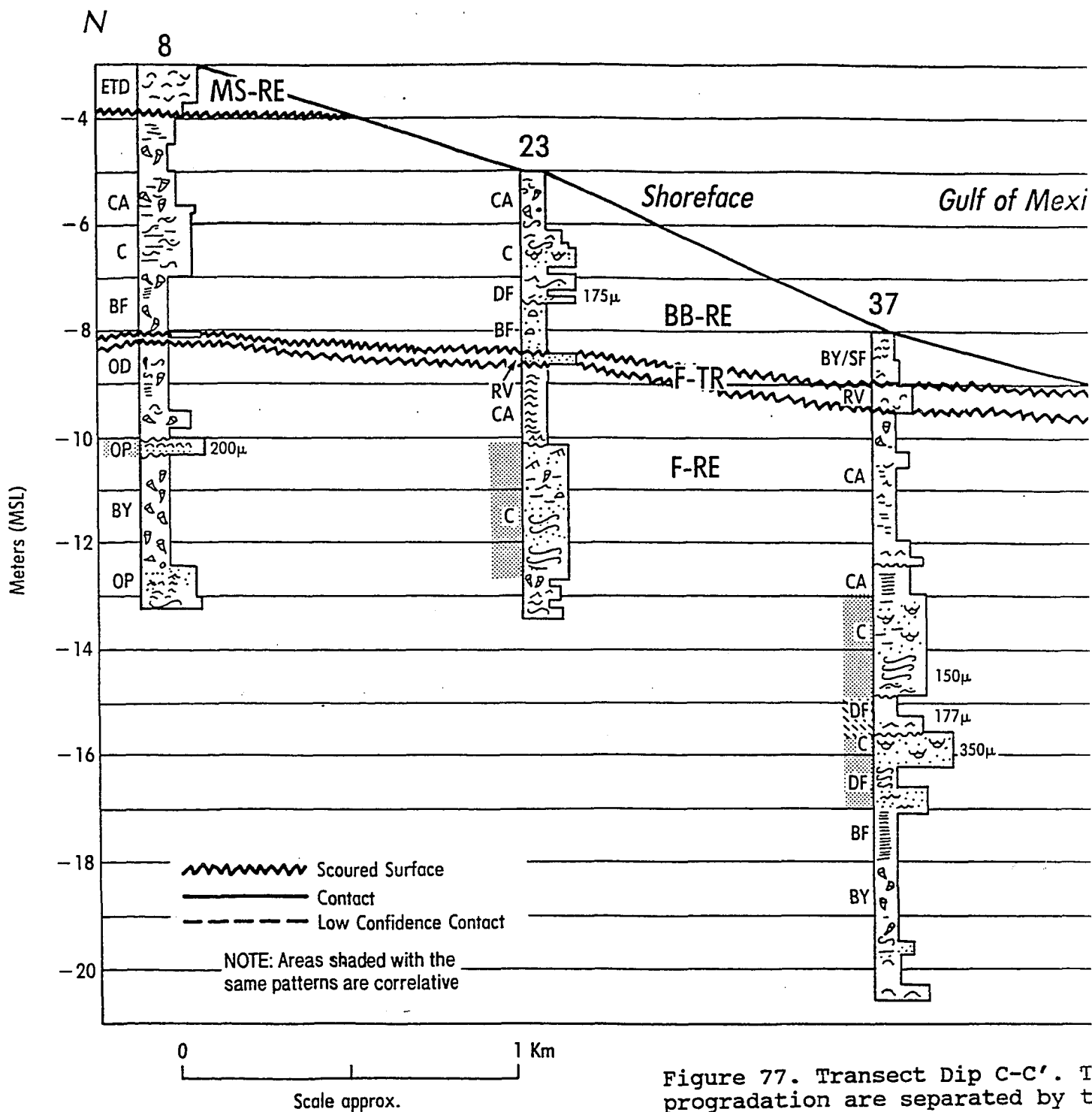


Figure 77. Transect Dip C-C'. The progradation are separated by the Families (F-Re) is the deepest

S

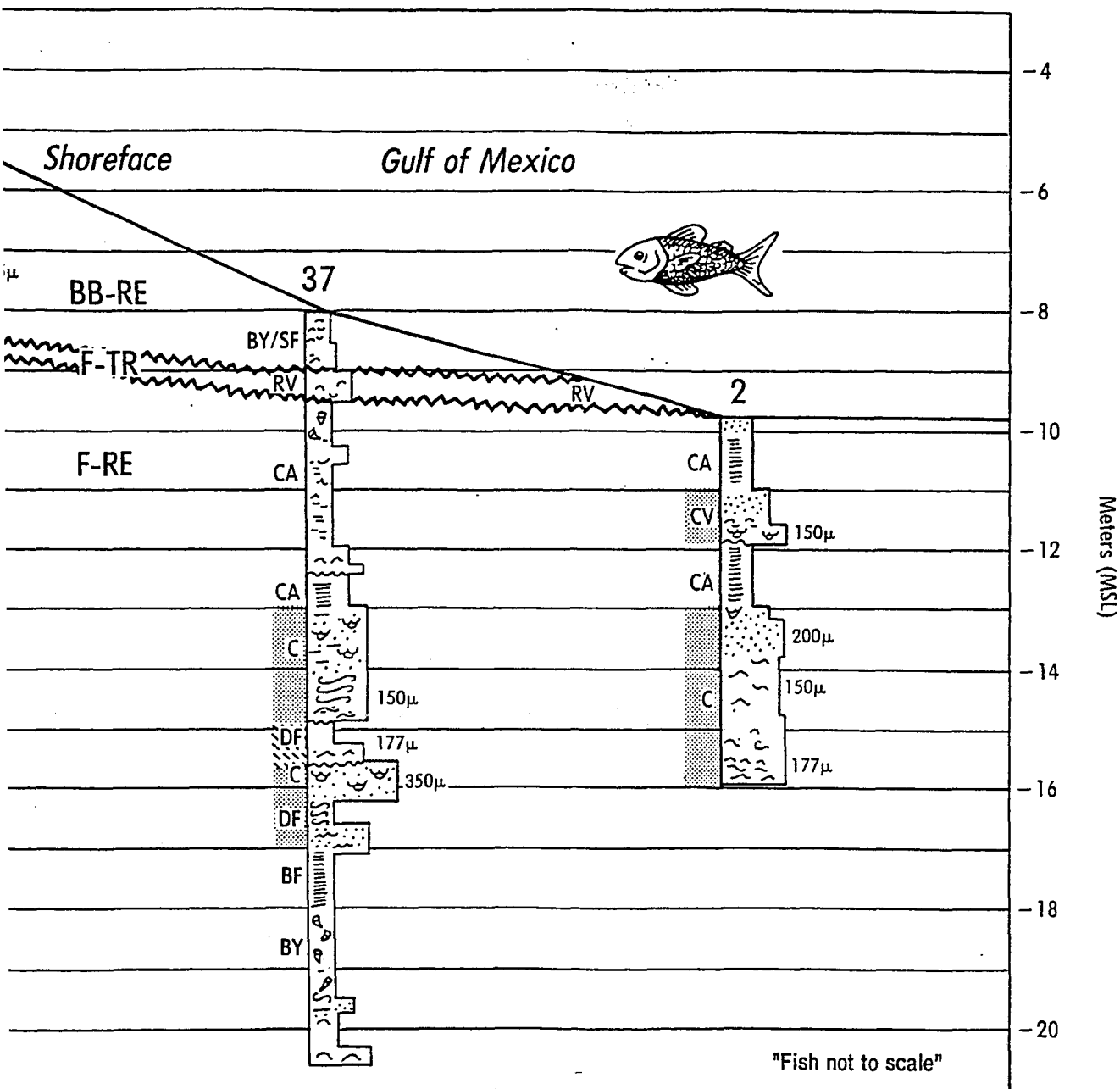


Figure 77. Transect Dip C-C'. Three periods of delta lobe progradation are separated by two transgressions. Bayou des Families (F-Re) is the deepest recorded delta progradation.

shoreline. There is over a kilometer of spacing between each core.

Transect C-C' / Parasequence F-Re

Description: Between -20 and -16 m, in core 37, burrowed muds grade to minutely laminated clays (Figure 77). The clays coarsen upward to delta front sands and then to trough-cross-bedded sands. The mean sand size in the active channel is 350 ϕ . These bedded sands are truncated at approximately -15.5 m and overlain by ripple bedded sands with a mean grain size of 177 ϕ . These sands grade to muds that are truncated at -15 m. Overall, the lower delta thickness exposed in this core is approximately 7 m.

The large difference in mean grain size and the sharp contact at -15 m suggests that the lower and upper sands are unconformable. However, the truncation of the channel sands does not represent the transgressive phase of delta lobe abandonment. Transgressive lags are normally coarser than the underlying units.

Active channel sands two to three meters thick in this interval are also seen in cores 23, 37 and 2 between -16 and -12 m. Channel sands of comparable thickness were found across transect A-A' at similar depths. No active channel facies were found in core 8. Instead, bayfill and proximal overbank facies are found within parasequence F-Re. Core 8 probably lies adjacent to thicker channel sands.

In parasequence F-Re the sediments fine to muds that

are truncated by a thin sandy unit between interval -9.5 and 8 m. If the sandy unit were present at this elevation further offshore (core 2) it has been removed by shoreface retreat.

Interpretation: Parasequence F-Re contains facies representative of a prograding delta lobe. There is no clear evidence of a transgression beneath -8 m. The stratigraphic implications are that evidence of a transgression, if one did occur, was erased when the overlying channel scoured down into older strata. The thickness and coarseness of this sequence suggests that this distributary probably captured a significant amount of the Mississippi River discharge during its period of activity. The vertical variation in lithology noted within the channel sequence in core 37 represents fluctuations in discharge through the distributary system. These fluctuations may have been partially influenced by sea level rise and fall delta lobe construction.

Transect C-C' / Parasequence F-Tr

Description: A thin unit of sand that overlies F-Re has sharp lower and upper contacts. This is the proposed contact between F-Re and BB-Re, located at a depth of -8.2 m in core 8 and -9.5 in core 2. The distance between these two cores is nearly 5.0 km. In core 37 this unit is nearly 0.7 m thick and contains sand and some Mulinia sp. shell

fragments.

Interpretation: Parasequence F-Tr is a ravinement surface formed during the transgression of F-Re. The top of Core 2 lies just below the elevation where this surface would be projected, if it continued offshore. Parasequence F-Tr appears too gentle to be the seaward sloping ramp of an eroding shoreface (Figure 77). It is more comparable to the pitch found on the floor of Barataria Bay (Figure 78). In that F-Tr has probably subsided significantly since it was deposited, yet still lies above the depth limit of shoreface retreat (below 9 m) , it is probably a bay ravinement.

Transect C-C' / Parasequence BB-Re

Description: Another stack of progradational delta facies are found between -9.5 and -4 m. Nearer to shore, cores 8 and 23 contain active channel sands incising underlying bayfill muds. The sandy channels have been filled with burrowed and laminated muds. Only the lower bayfill facies of Parasequence BB-Re has survived the shoreface retreat in core 37 (-9.2 to -8 m). At core 2, shoreface erosion has removed any evidence of BB-Re above -9.5 m.

Interpretation: Parasequence BB-Re is a delta lobe complex that is presently being truncated by shoreface retreat. Seismic records taken along this transect illustrate the truncation of several meters of sediment as the shoreface is eroded (Figure 79).

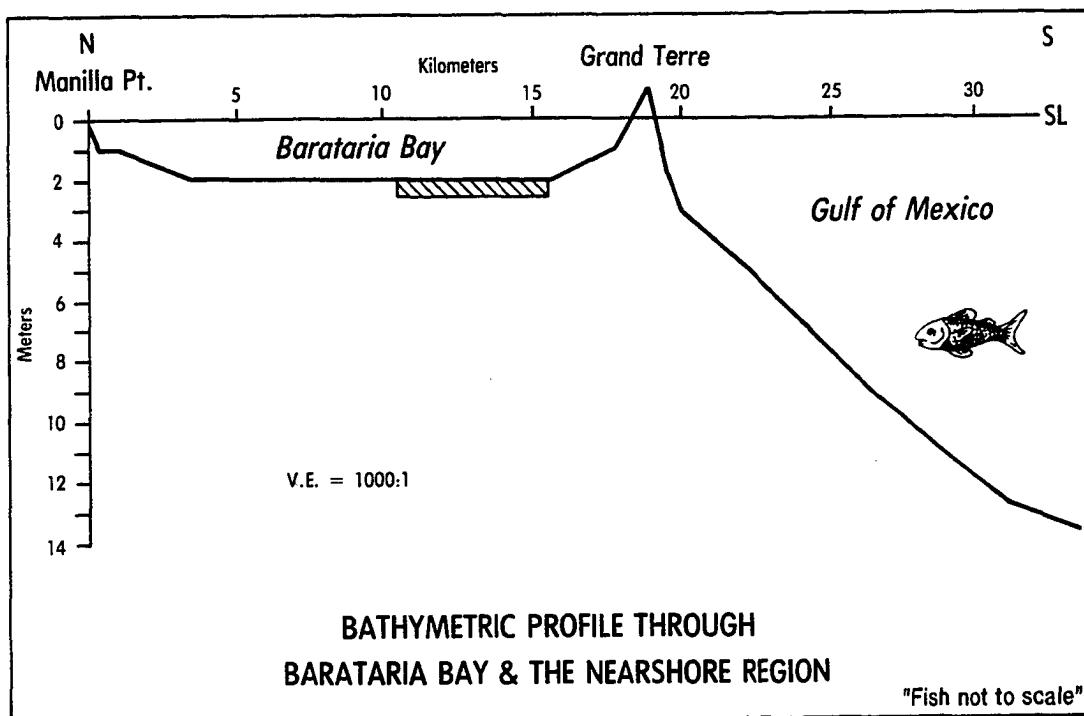
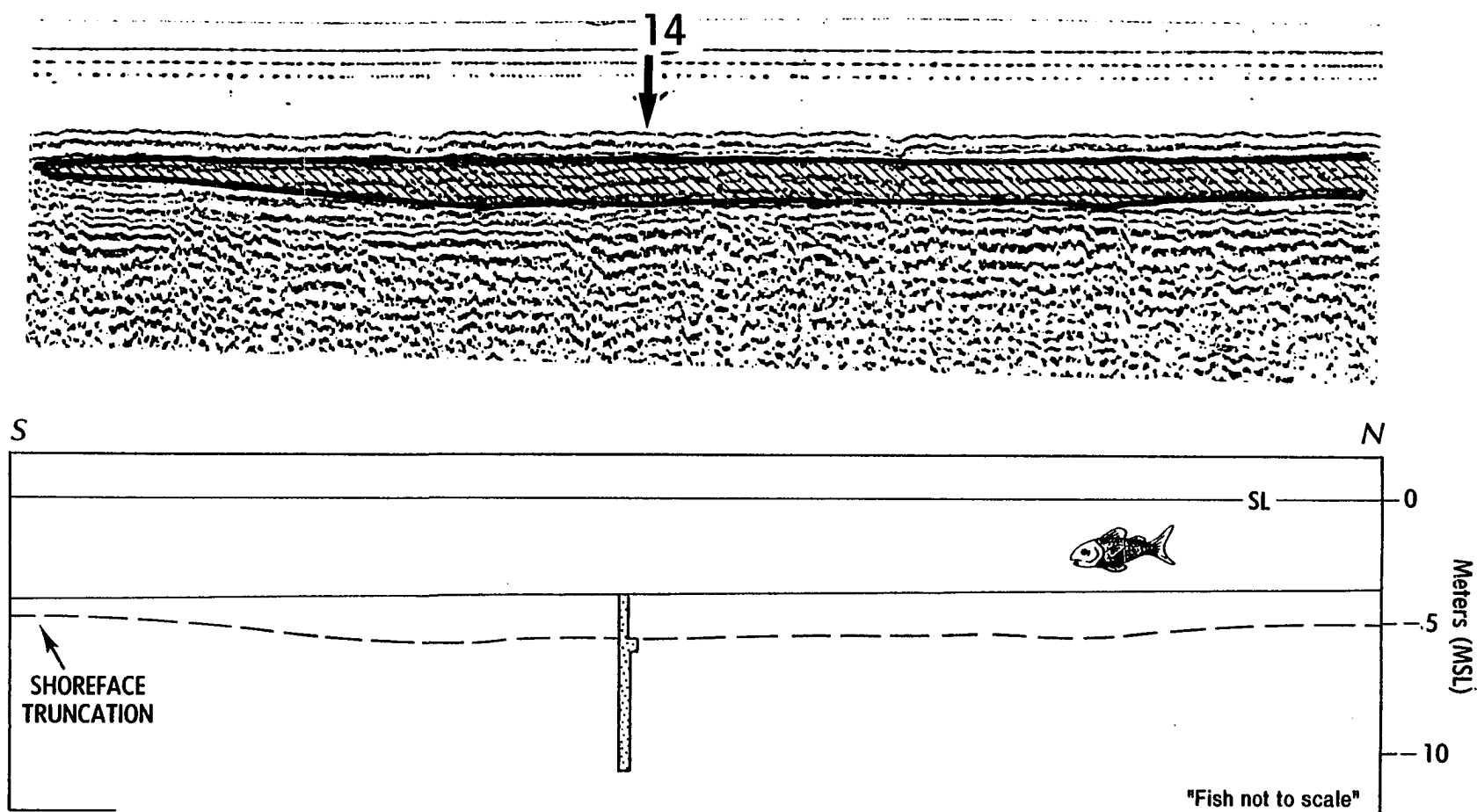


Figure 78. Bathymetric profile from Manilla Pt., Barataria Bay to Grande Terre and offshore to approximately 14 m depth. Note that there does not appear to be a leveling of the shoreface at the proposed 9 m limit of wave base.



Transect C-C' / Parasequence BB-Tr

Description: The upper portion of core 8 at -4 m exhibits a truncation between BB-Re and the overlying ebb-tidal delta sands. Further offshore this parasequence is truncated by the present shoreface.

Interpretation: Parasequence BB-Tr is actually only a contact that lies between BB-Re and the ebb-delta facies. The depth of this ravinement surface is shallower than the 9 meter depth limit of shoreface retreat. There is not enough information to ascertain whether it is part of the upper shoreface portion of a ravinement surface or a bay ravinement.

Transect C-C' / Parasequence Ms-Tr

Description: In Core 8 the contact between BB-Re and overlying shell-rich sands is sharp. The sands are part of the ebb-tidal delta fronting Quatre Bayou Pass.

Interpretation: The origin of the shelly sands that comprise this parasequence is undecided. It may be a barrier shoreline lag ,or, in accordance with a theory proposed by Howard (1983), an accretionary feature deposited onto the shoreface. In any event the sands overlying the finer grained facies of BB-Re are evidence of a recent retrogradational, regressive period of sedimentation.

5. PASS ABEL STRATIGRAPHY

DATA DESCRIPTION

Seventeen vibracores were taken from four cross-sections within Pass Abel and the adjacent barrier shoreline (Figure 80). Transect PAW crosses the barrier spit on the east end of Grande Terre. Additional cores (S-1, S-2 and T-3) were taken through the spit to better define its stratigraphy. Transect PAN is oriented normal to the channel thalweg. Transect PAE extends shore normal across Bay Melville (Figure 80). Transect PAS spans the inlet throat on line with the present shoreline. Waves made coring treacherous in this area and did not allow a full compliment of samples to be taken.

Transect PAN - Description and Interpretation

Transect PAN / Parasequence F-Tr

Description: Core PAN-5 and PAN-2 (Figure 81) contain small disarticulated Rangia cuneata valves in sands beneath -7.4 m. Rangia sp are indigenous to bays with salinities that fluctuate seasonally between 2 and 18 ppt (Cain, 1972). High densities of Rangia cuneata are found within sandy/muddy substrates in brackish, turbid waters that are rich in nutrients (Tarver and Dugas, 1972).

Interpretation: Due to limited sampling at this depth an environmental interpretation is tentative. The high sand

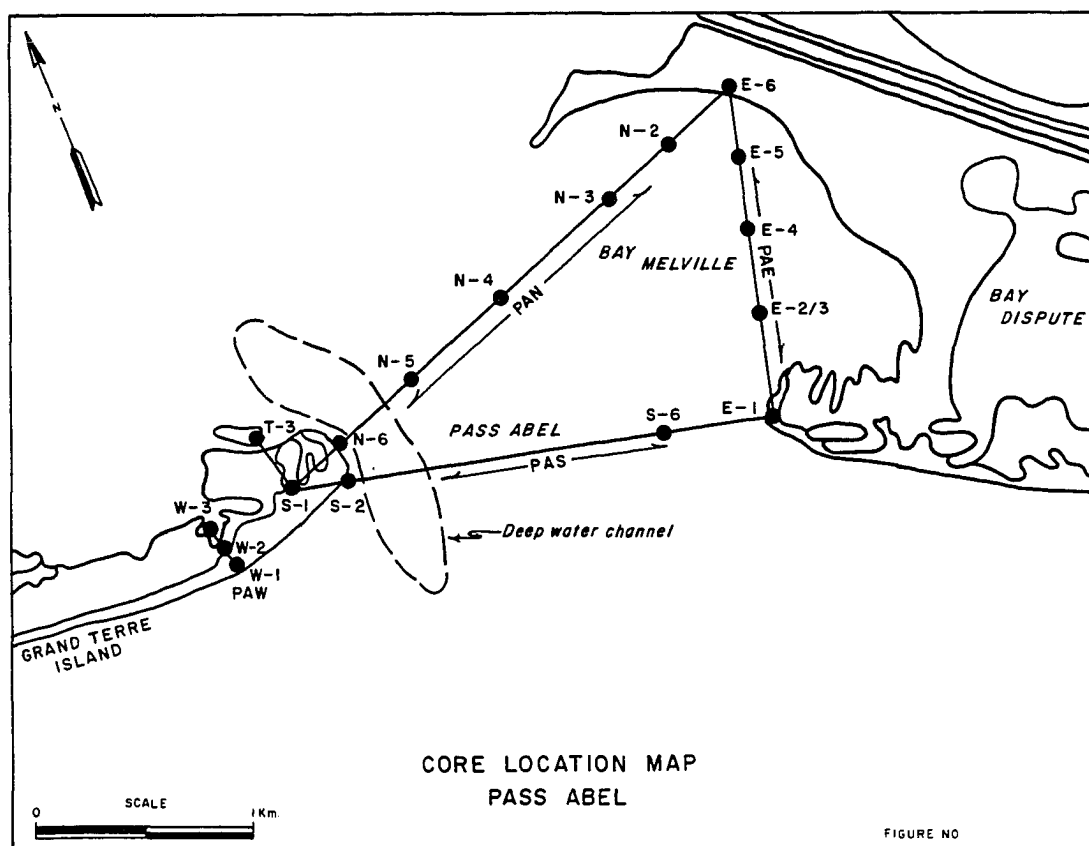


Figure 80. Locations of cores taken in the Pass Abel area.

CROSS SECTION PAN

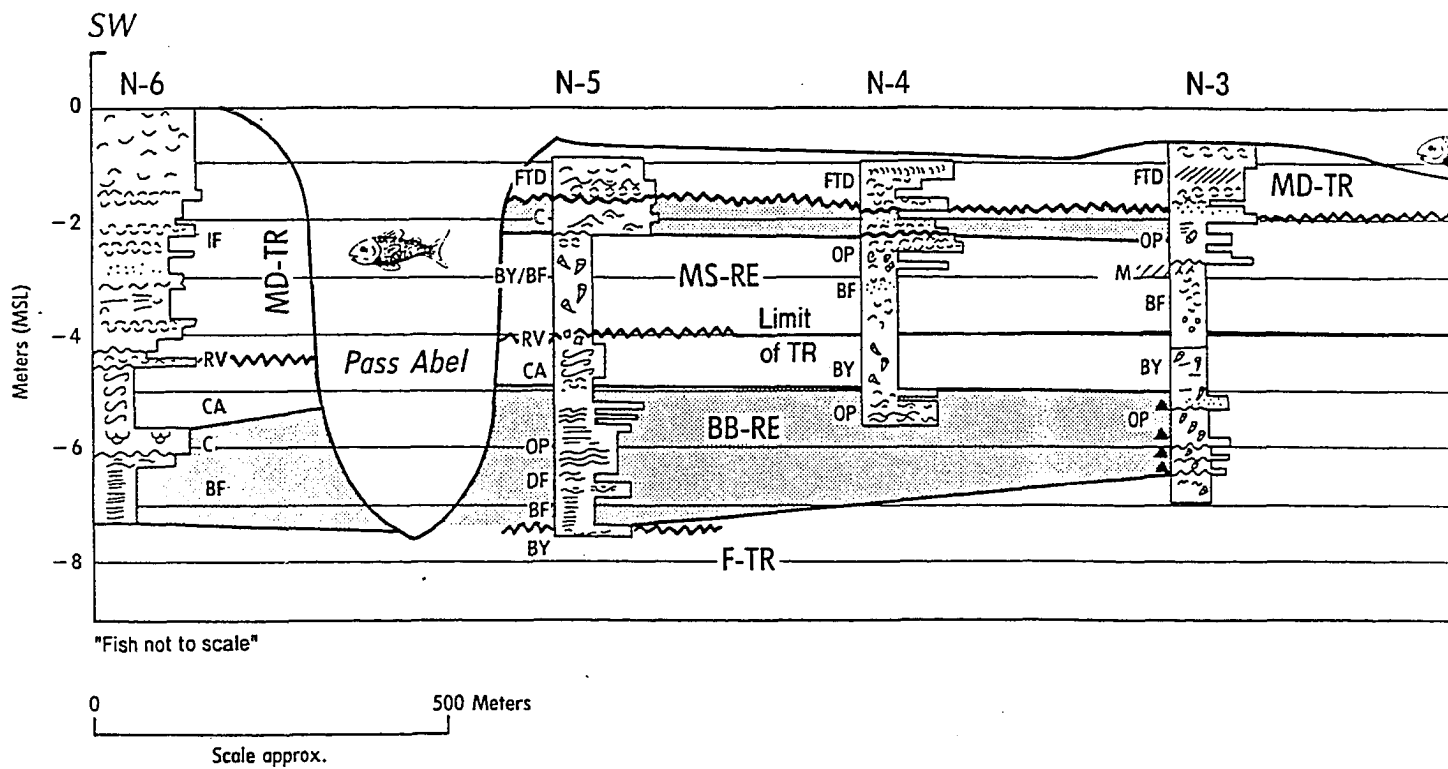
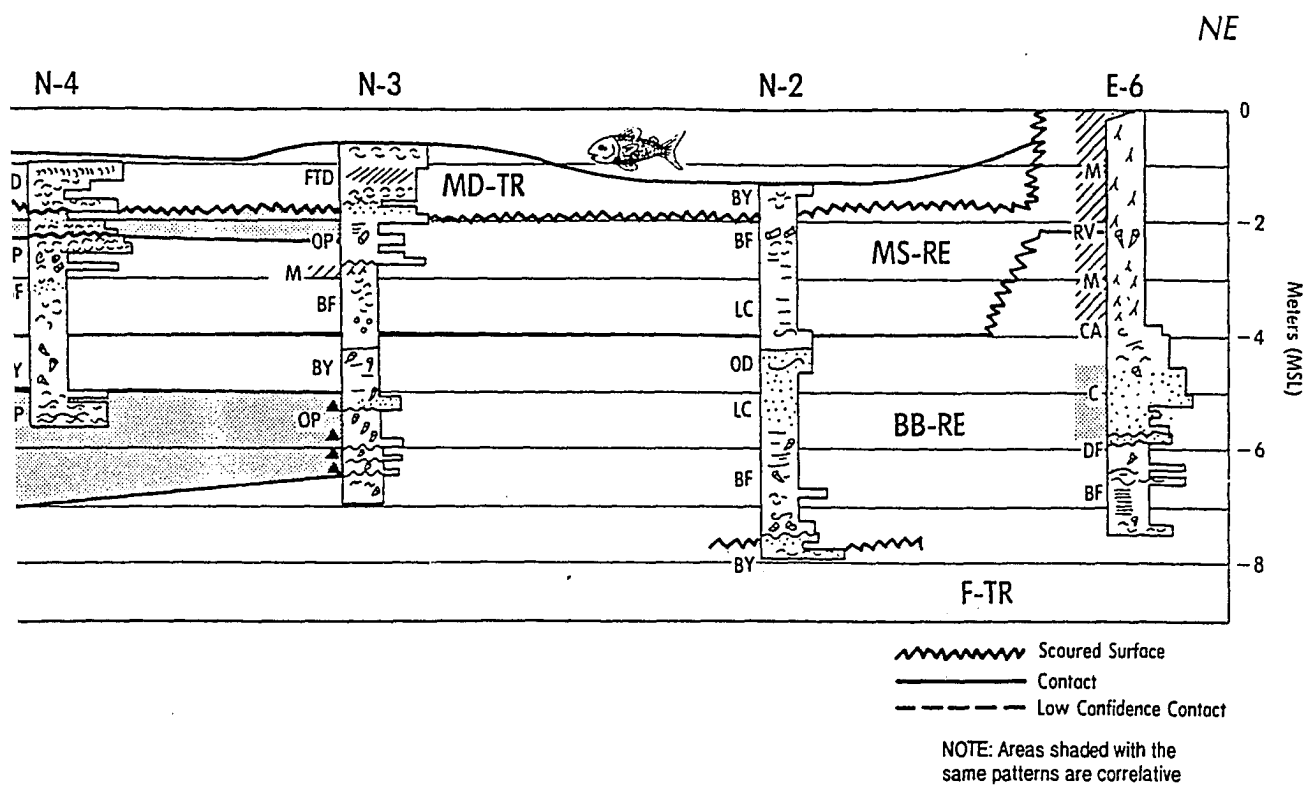


Figure 81. Transect PAN. Overbank deposits in sequence BB- exhibit decreased bed shear effects with distance from Pas Abel channel. Pass Abel was probably a distributary during the Bayou Blue Progradation.



Overbank deposits in sequence BB-Re
 ar effects with distance from Pass
 as probably a distributary during
 on.

content in the substrate suggests that this is not the bay environment that originally supported the Rangia sp. Either the fines have been winnowed out or the shells have been transported in and mixed with the sands. Based on this data, the environment of deposition is interpreted to be a transgressed open interdistributary bay.

Transect PAN / Parasequence BB-Re

Description: Cores PAN-5 and PAN-6 contain laminated bayfill silty clays that coarsen to alternating beds of silts and sands between -7 and -5 m. Laterally thinning strata between -7.5 and -5 m in cores PAN-4, PAN-3 and PAN-2 suggest more distal overbank deposits. Parasequence BB-Re is capped by fining units of interdistributary bay fill. The bay fill is initially free of shell material.

Landward, BB-Re contains an 8 m thick regressive parasequence (Figure 81). Bayfill and delta front muds coarsen to channel sands between -6 and -4 m. A 0.5 m thick abandoned channel facies is overlain by four meters of delta plain marsh. The marsh unit contains a thin burrowed, muddy stratum at -2.1 in core PAE-6. This thin marker bed has been used to separate the marsh into two temporally different units.

Interpretation: Active and abandoned channel facies, and a framework of overbank deposits flank Pass Abel channel between - 7.5 and -4.5 m. Parasequence BB-Re represents a delta progradation.

Transect PAN / Parasequence BB-Tr

Description: A two meter thick burrowed, mud facies dominates the central portion of transect PAN between -5 and -3 m. Varying concentrations of Rangia cuneata valves and fragments are only found above -4 m. In core PAN-3 roots of a buried marsh cap the muds at -2.9 m.

Interpretation: Rangia cuneata require seasonal fluctuation of salinity in order to survive. The incursion of brackish water fauna at -4.0 probably defines the Bayou Blue bay ravinement surface. There is no indication of a more saline environment occurring in the lower units.

Transect PAN / Parasequence Ms-Re

Description: In parasequence Ms-Re muddy clays and silts grade to sands. Core PAN-5 contains trough cross-bedded active channel sands between -2.0 and -1.5 m. The sands are gray due to high concentrations of heavy minerals. Across the channel in core PT-3 a similar unit of sands and clay rip-up clasts grade to heavily rooted clays (Figure 82). Horizontally bedded Rangia cuneata rich sands lie to the east of the channel sands in core PAN-4. In core PAN-2 and 3, overbank facies related to the channel are present at similar levels.

Interpretation: The bedded sands that straddle the present channel location are part of the Ms-Re delta progradation.

CROSS SECTION T-3 to N-5

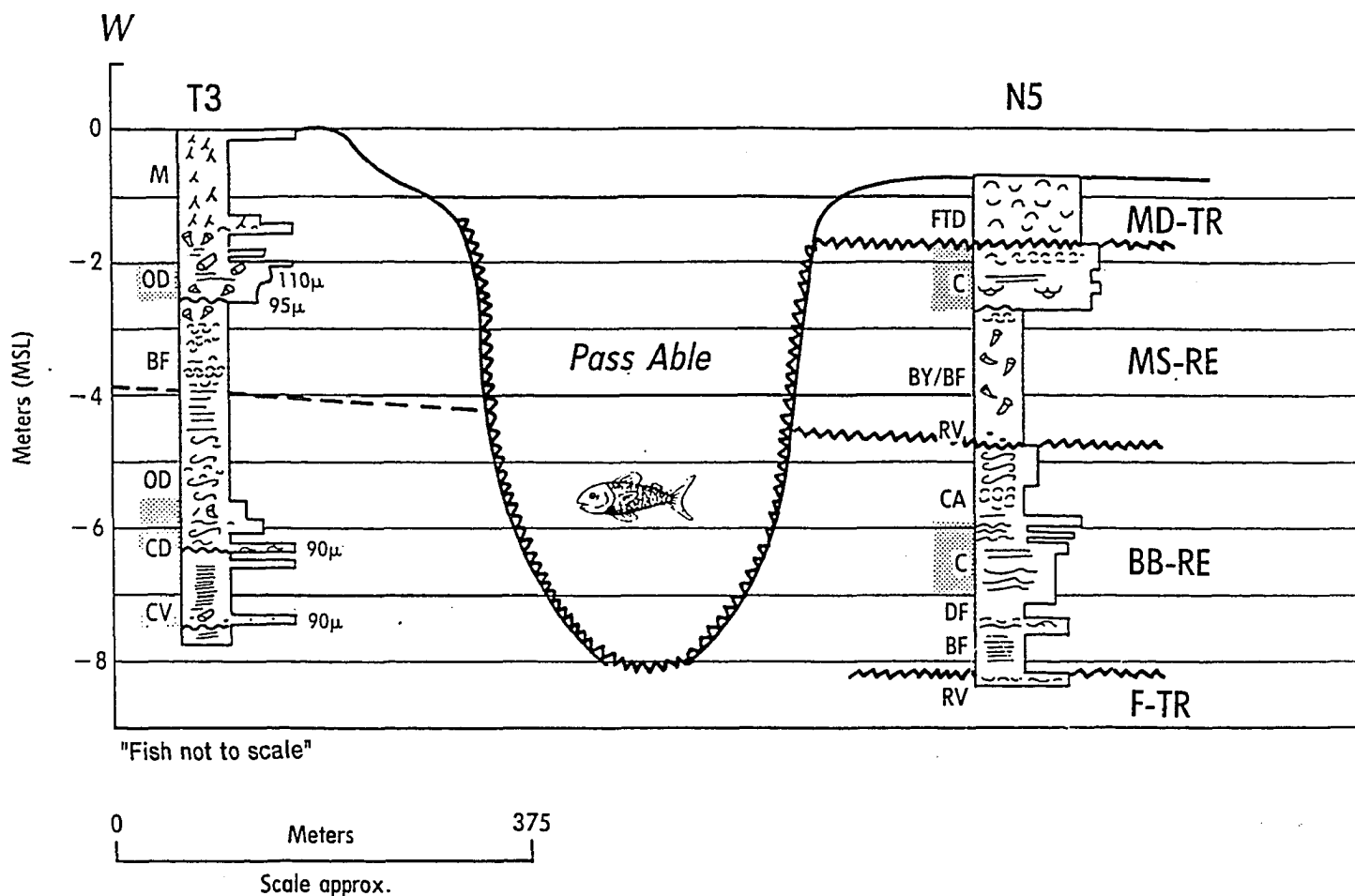
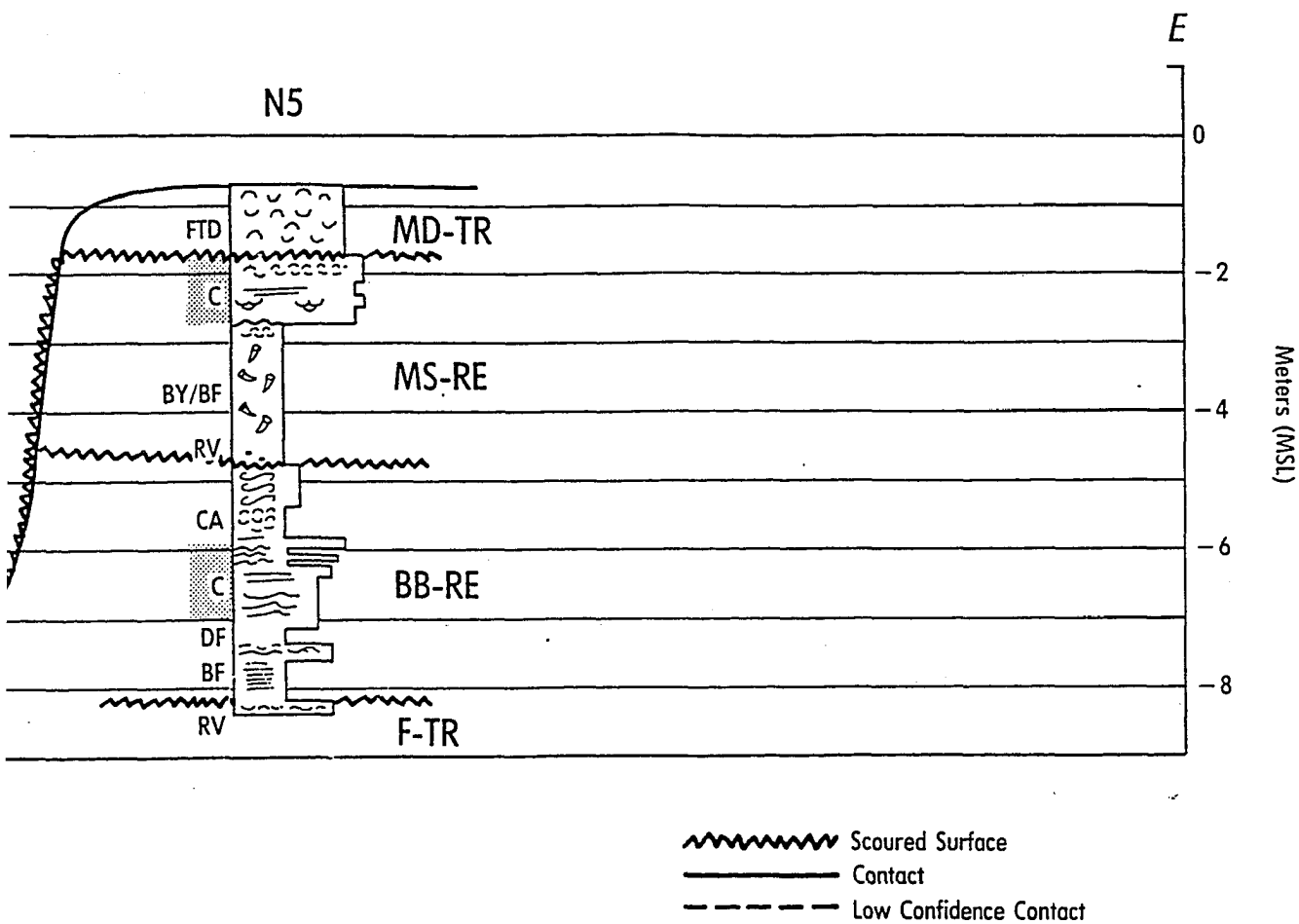


Figure 82. Transect PAT-3 to PAN-5. Proximal overbank deposits on either side of Pass Abel in sequence MS-Re, to -2.0 m, suggest that the Pass Abel channel was also site of a Mississippi Lobe distributary.



PAT-3 to PAN-5. Proximal overbank
 side of Pass Abel in sequence MS-Re, -2.5
 hat the Pass Abel channel was also the
 i Lobe distributary.

The proximity of these facies to the present channel suggests that they originated from a channel that flowed in the same path as the present Pass Abel. The shells within the overbank unit in core PAN-4 are Rangia cuneata. These shells may have been washed landward during an intensified wave event that attacked the seaward delta shoreline. The location of this strata landward of gulf influences is suggested by the lack of more salt tolerant species, such as Crassostrea virginica, found intermixed with brackish faunal remains.

Transect PAN / Parasequence Md-Tr

Description: Shell rich sands carpet most of the bay floor between -2.0 m and the sediment/water interface. A sandy shell hash cored in surficial sediments of cores PAN-3 and PAN-4 define the landward thickening flood-tidal delta. Identifiable species represented in the shell hash include Crassostrea virginica, Rangia cuneata, and Thais haemastoma.

The base of Md-Tr has a lower shell content and occasional Callinassa major burrows. The average sand thickness in Md-Tr east of the channel is 0.85 m. On the west side of Pass Abel channel a 4.2 m thick channel fill consists of alternating strata of shell and sand. This fill is correlated to Md-Tr.

Interpretation: Parasequence Md-Tr is part of the most recent transgression. Material eroded from the present

shoreline is being transported landward onto the bay bottom. This is confirmed by recent map history and the shell types distributed within the sands. The shell types represent a cross-section of salinity tolerant fauna that would be expected in a shoreward transgressed barrier complex. The fill on the west side of the transect is the result of sand transported from the Grande Terre foreshore into the tidal channel margin.

Transect PAE - Description and Interpretation

Transect PAE / Parasequence F-Tr

Description: Cores PAE-5 and PAE-6 penetrate to below 7.5 m (Figure 83). At this level bay fill muds contain shell fragments of Crassostrea virginica and Rangia cuneata.

Interpretation: The mixed shell types suggest a transgressive open bay. This is being filled by bayfill muds of the early BB-Re progradation. The contact between F-Tr and BB-Re is placed somewhere between -7.5 m and -6.5 m. The average beginning of bayfill muds of BB-Re in cores E-4 through E-6 is 6.8 m.

Transect PAE / Parasequence BB-Re

Description: The muds at the base of core PAE-4 (Figure 83; -7.5 m) are mixed with 'coffee grounds'. Coffee grounds precede the building of small crevasse systems in the Colorado Delta, Texas (Kanes, 1970). The strata at the base of core PAE-4 is part of a bay fill. Laminated bay

fill clays found in cores PAE-4 through PAE-6 (-7.2 to -6 m) exhibit sharp contacts to delta front and channel facies. Parasequence BB-Re thickens landward and is capped by marsh. A sample of marsh removed from core PAE 2/3 was radiometrically dated at 1970 +/- 60 ybp.

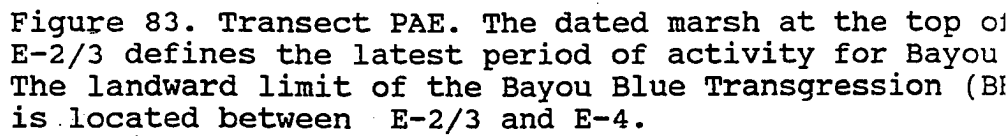
Interpretation: Parasequence BB-Re is part of a delta lobe built over two thousand years ago. The total thickness of sands in parasequence BB-Re is less than two meters suggesting that transect PAE lies to the side of the main channel. BB-Re has been removed by a later transgression. This explains the apparent landward thickening of BB-Re.

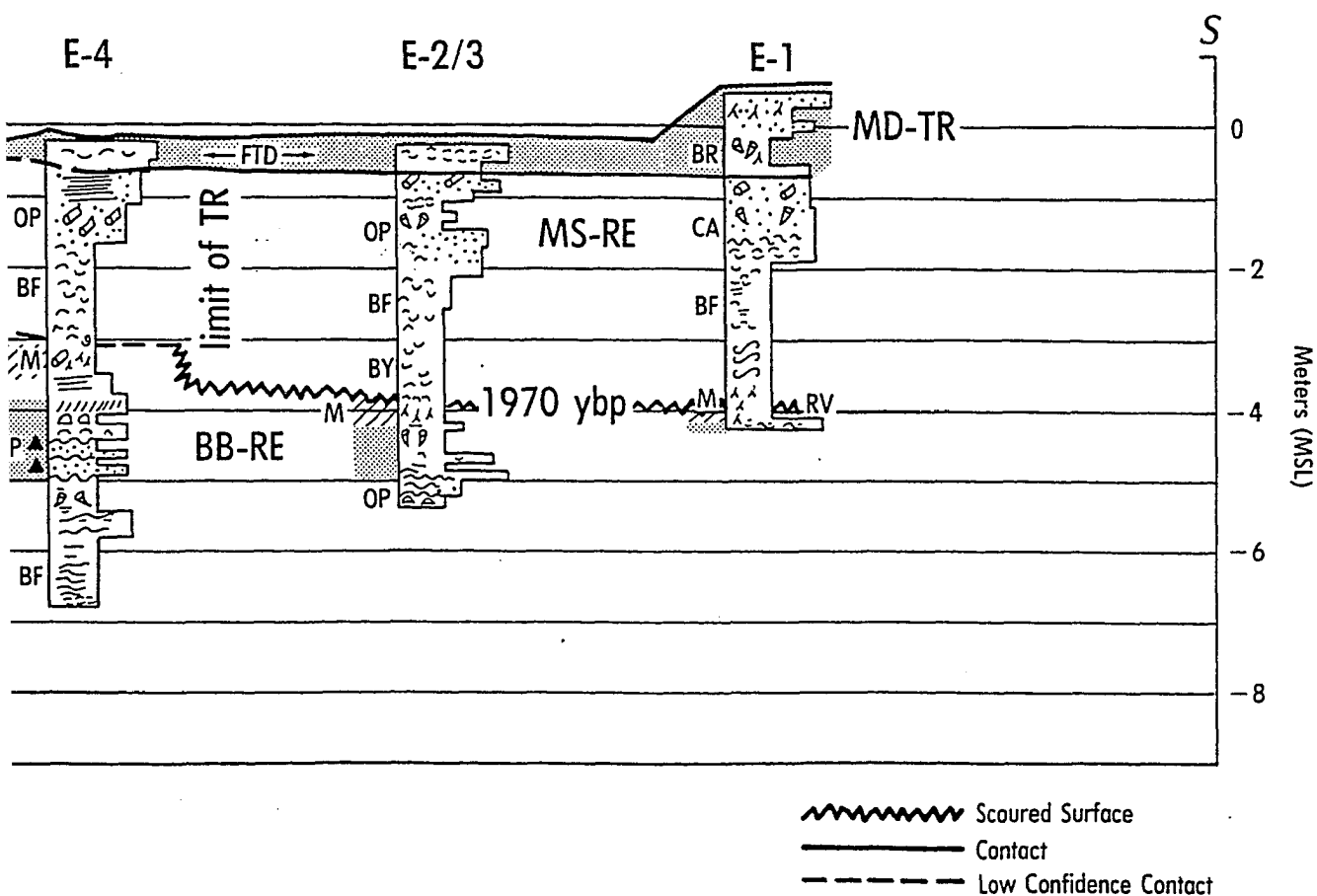
Transect PAE / Parasequence BB-Tr

Description: Delta plain marsh in cores E-1 to E-2/3 are buried beneath shelly bayfills and distorted muds at -3.9 m. This apparent truncation disappears between E-2/3 and E-4.

Interpretation: The sudden change in vertical lithologies suggests that a transgressive surface separates BB-Re and Ms-Re. The landward limit of this transgression is located just landward of E-2/3. A vertical contact is depicted between cores E-2/3 and E-4 (Figure 83). This defines the contact between the landward transgressing shoreline and the seaward limit of the delta plain marsh. It is common-place to see shear drop-offs between the marsh and adjacent bay

N
E-6 E-5 E-4 E-2/3





PAE. The dated marsh at the top of core test period of activity for Bayou Blue. f the Bayou Blue Transgression (BB-Tr) E-2/3 and E-4.

CROSS SECTION PAE to C'

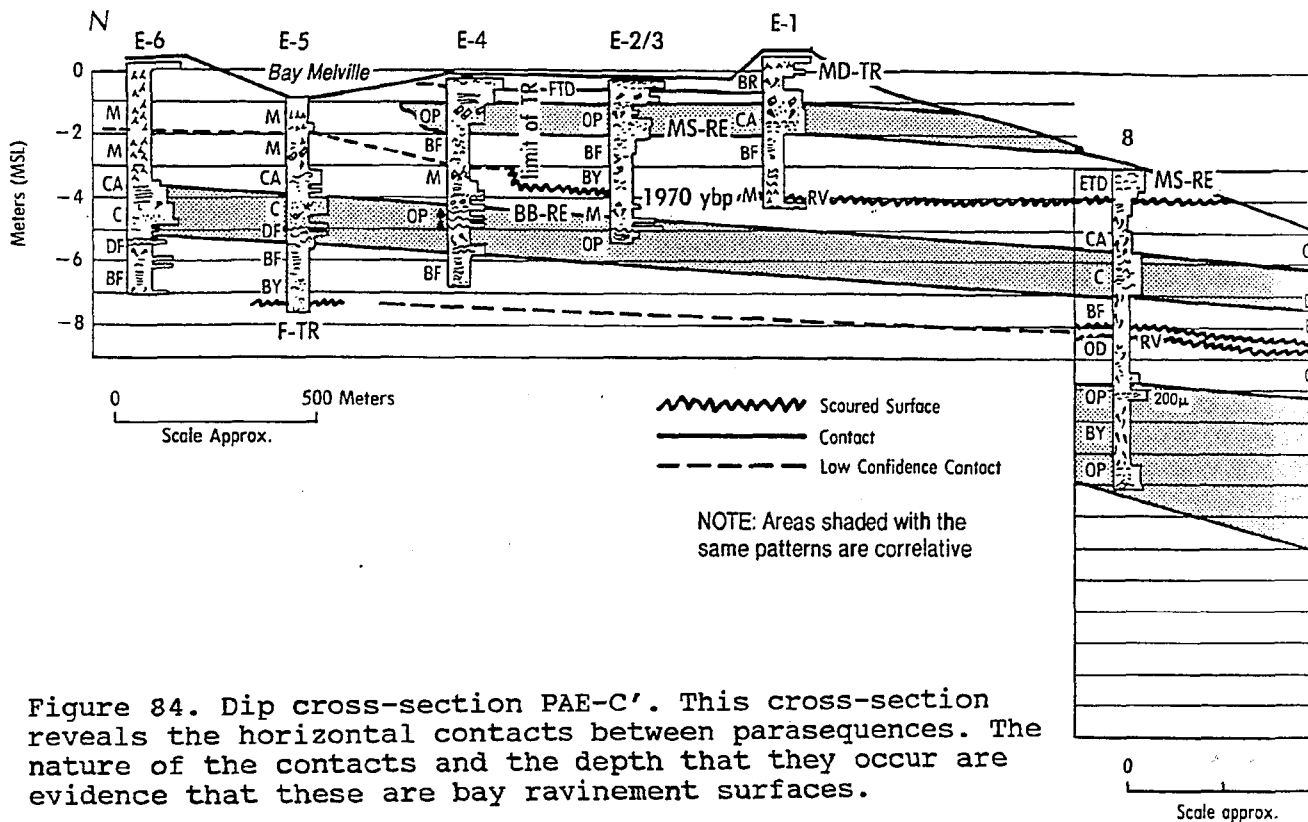
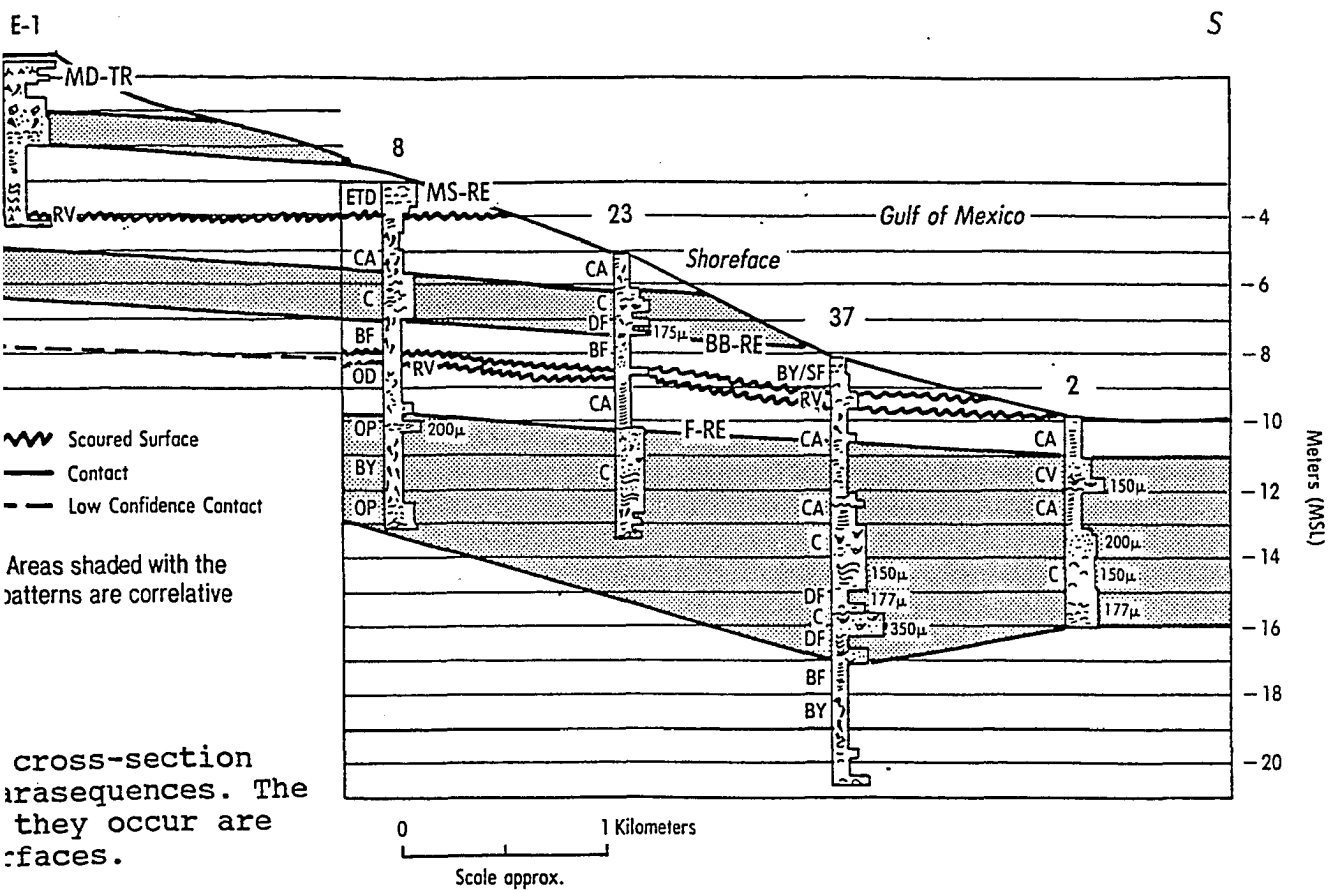


Figure 84. Dip cross-section PAE-C'. This cross-section reveals the horizontal contacts between parasequences. The nature of the contacts and the depth that they occur are evidence that these are bay ravinement surfaces.



within the present day delta plain. The deeper water facies overlying the marsh in this transect suggest that this transgressive surface defines a bay ravinement.

This interpretation is further supported by matching the offshore dip section C-C' to transect PAE (Figure 84). The interpreted level of the BB-Tr is at approximately the same level as in core 8 taken nearly a kilometer seaward. If this contact defined a shoreface ravinement it would be expected to take on a similar slope to that attained on the present shore. It does, however, mimic the level surface of Barataria Bay. Based upon this analysis it appears that BB-Tr is a bay ravinement.

Transect PAE/ Parasequence Ms-Re

Description: The dated marsh in BB-Re is buried by bay muds of Ms-Re in cores PAE-2/3 and PAE 4 (Figure 83, -3.7 to 2.0 m). The muds contain moderate to abundant Rangia cuneata. Cores PAE-1 and PAE-2/3 contain sands between -2.2 and -1.2 m that pinch out landward. Thin overbank deposits containing immature sands with bedded organics and woody debris are located in cores PAE-4 (-1.8 to -1.2 m) and PAE-1 (-1.4 to -1.2 m).

Interpretation: The two meter thick bay muds and Rangia cuneata are part of the bayfill of lobe Ms-Re. The sands described in this parasequence are part of a prograding delta lobe.

Transect PAE / Parasequence Md-Tr

Description: Cores PAE-1 to PAE-4 generally contain coarsening upward lithologies between elevation -0.8 and +0.5 m . In cores PAE-2/3 and PAE-4 between -1.0 and -0.5 m. sands with clay laminations coarsen upward to shell-rich sands of a flood-tidal delta. The sand percentage and mean grain size also increases in core PAE-1 between -0.7 and +0.5 m.

Interpretation: Parasequence Md-Tr represents the most recent transgression of Grande Terre Island. The sands are washed landward from the present barrier foreshore.

Transects PAW and PAS - Description and Interpretation**Transects PAW/PAS / Parasequence BB-Re**

Description: Core PAW-3 contains laminated clays that coarsen to horizontally bedded sands (Figure 85) between -6.2 and -5 m. No other cores in transect PAW penetrated to these depths. Burrowed bayfill muds are prevalent beneath Grande Terre spit between -5.0 and -3.0 m. Approximately 0.5 km to the east, core PAT-3 (Figure 82) contains bayfill clays that coarsen to thin, ripple-bedded sands between -7.5 and -5 m. In core PAS-2 (Figure 86), between -6 and -3.4 m, delta front muddy sands grade to ripple-bedded immature channel sands. The sands fine to muds with wood debris. The muds are burrowed and contain little shell material. Parasequence BB-Re is terminated at about -3.4 m

CROSS SECTION PAW

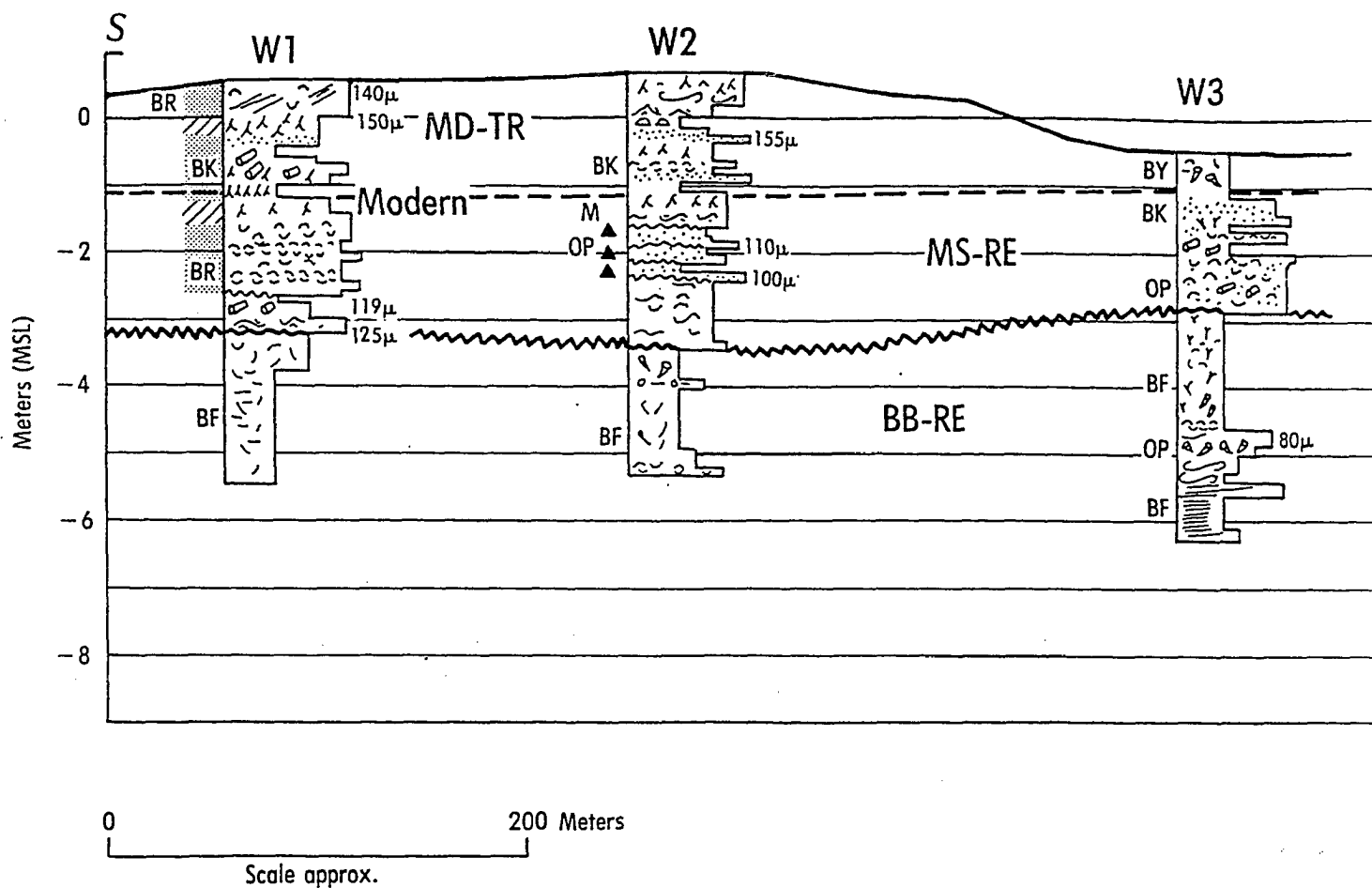
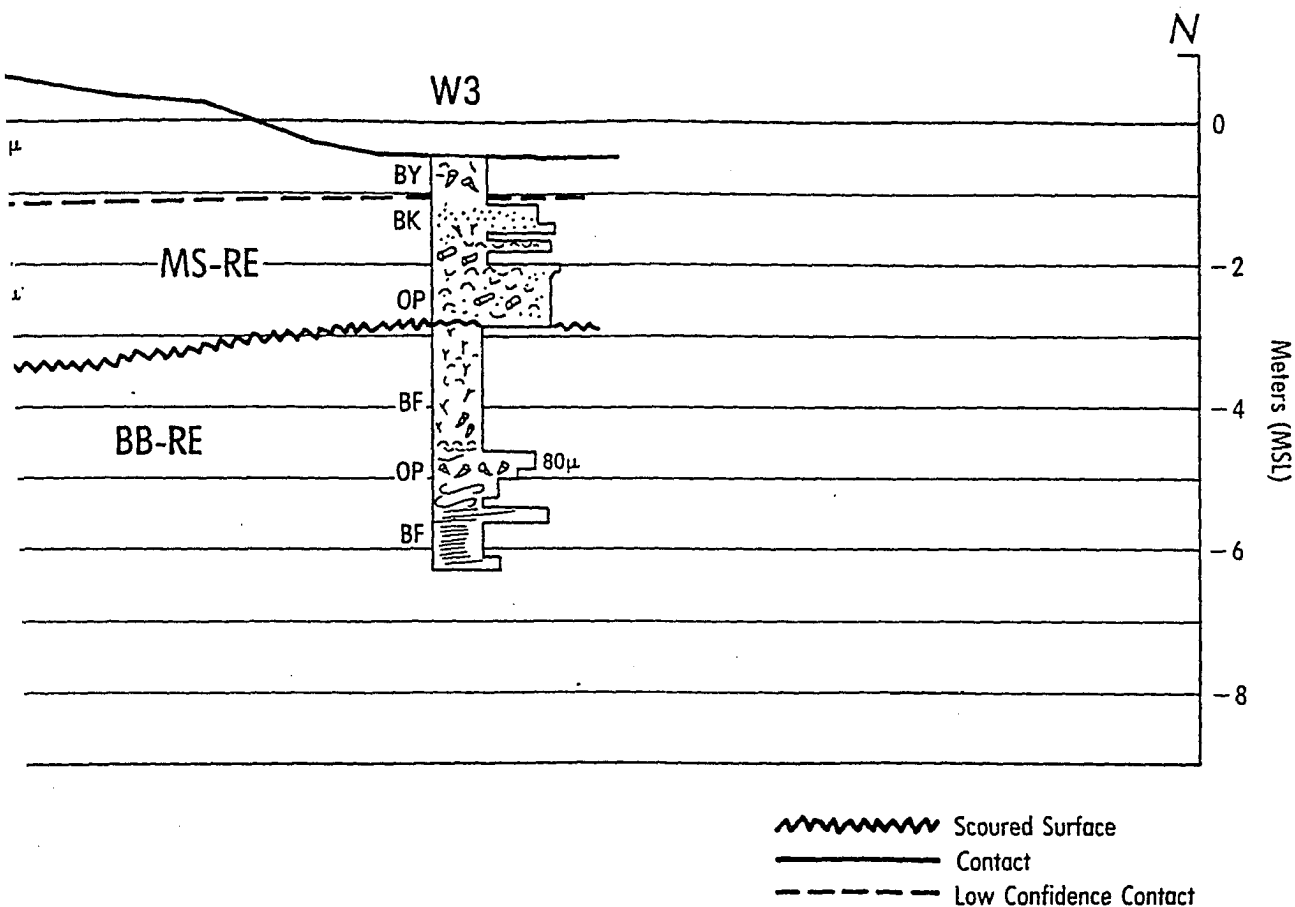


Figure 85. Transect PAW. This transect was taken across the eastern side of Grande Terre Barrier Island. The Modern C-14 date at -1.0 m in core PAW-1 marks the top of the Mississippi Lobe progradation and the inception of the modern transgression.



NOTE: Areas shaded with the same patterns are correlative

transect was taken across the barrier Island. The Modern C-14 marks the top of the and the inception of the

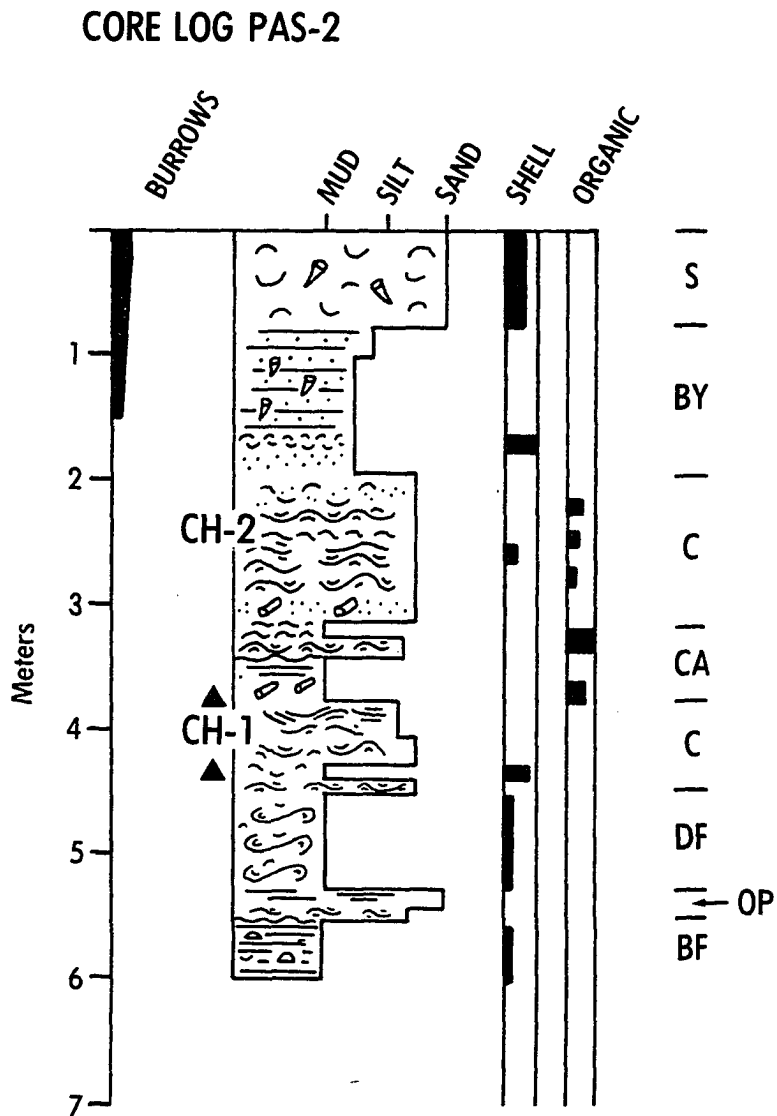


Figure 86. Core PAS-2. Two periods of active channel sedimentation are exhibited in this core. BB-Re in the lower section -5.5 to -3.4, and Ms-Re from -3.4 to -2.0. These channels are separated by BB-Tr, the Bayou Blue transgression.

by a transgressive shell lag.

Interpretation: BB-Re is a bayfill/channel complex. Based upon the presence of active channel and proximal overbank facies to the east, the source of the parasequence BB-Re was probably located in the vicinity of the present Pass Abel channel.

Transect PAW/PAS /Parasequence BB-Tr

Description: Numerous articulated and disarticulated Rangia cuneata valves were extracted from a twenty-centimeter-thick sandsheet in core PAS-1 at -3.4 m (Figure 87). Two shell samples were dated using Carbon-14. One sample indicated an age of burial approximately 3700 ybp +/- 100 yrs and the other 3140 +/- 120. The laboratory was more confident in the older date due to the fact that the sample shells were etched to a pearly surface which is optimum for accurate dating. The younger dates were obtained from a smaller sample size of shells that were chalky.

Interpretation: The absolute age of the shells does not necessarily date the surface on which it lies. The dangers of correlating radiometric dates of allochthonous debris with the origin of its surrounding depositional environment has been discussed during other stratigraphic investigations along the Mississippi River delta plain (Gerdes, 1985). Transported debris may represent much older material than the surrounding strata. The 3700 ybp C-14

CROSS SECTION PAT

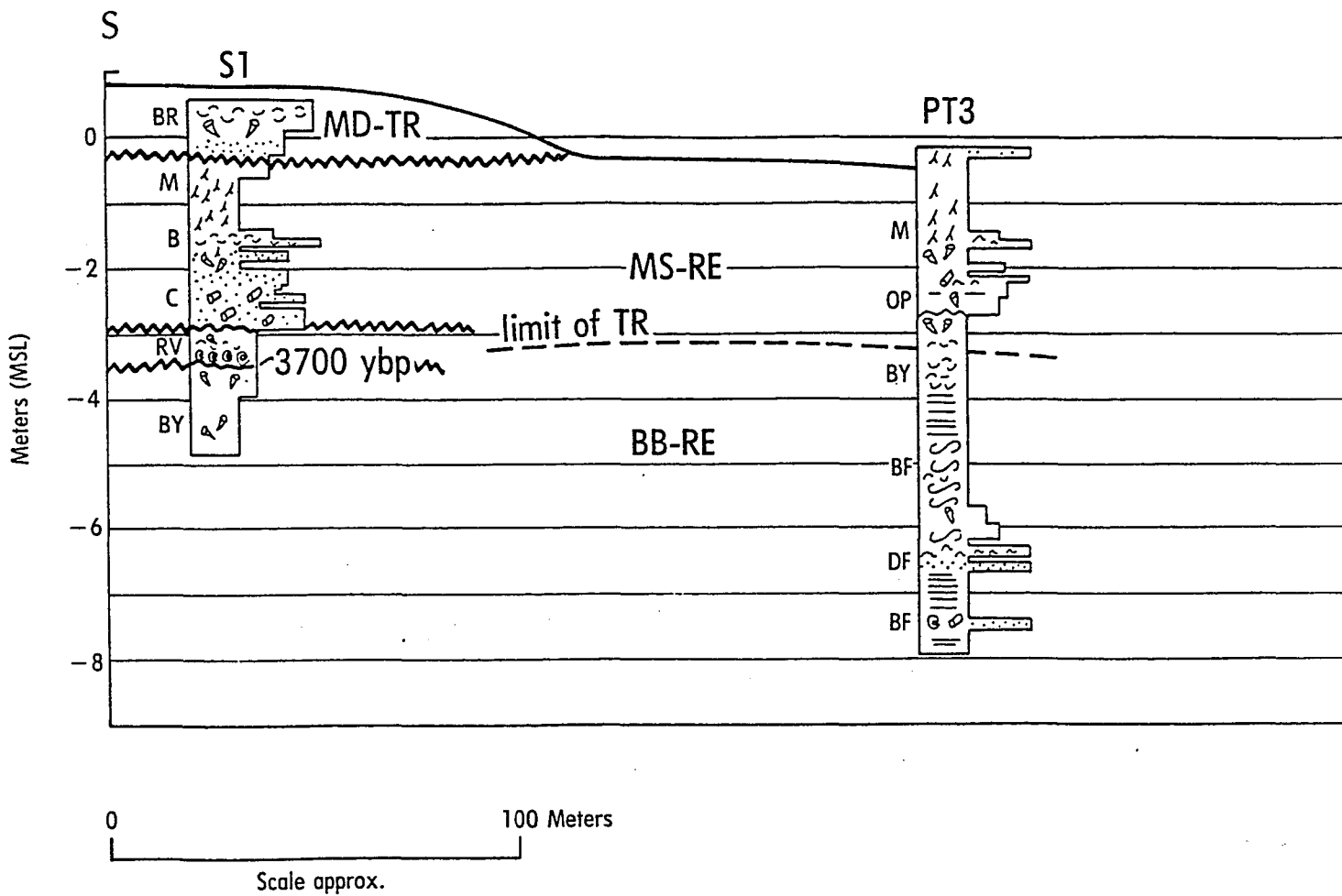
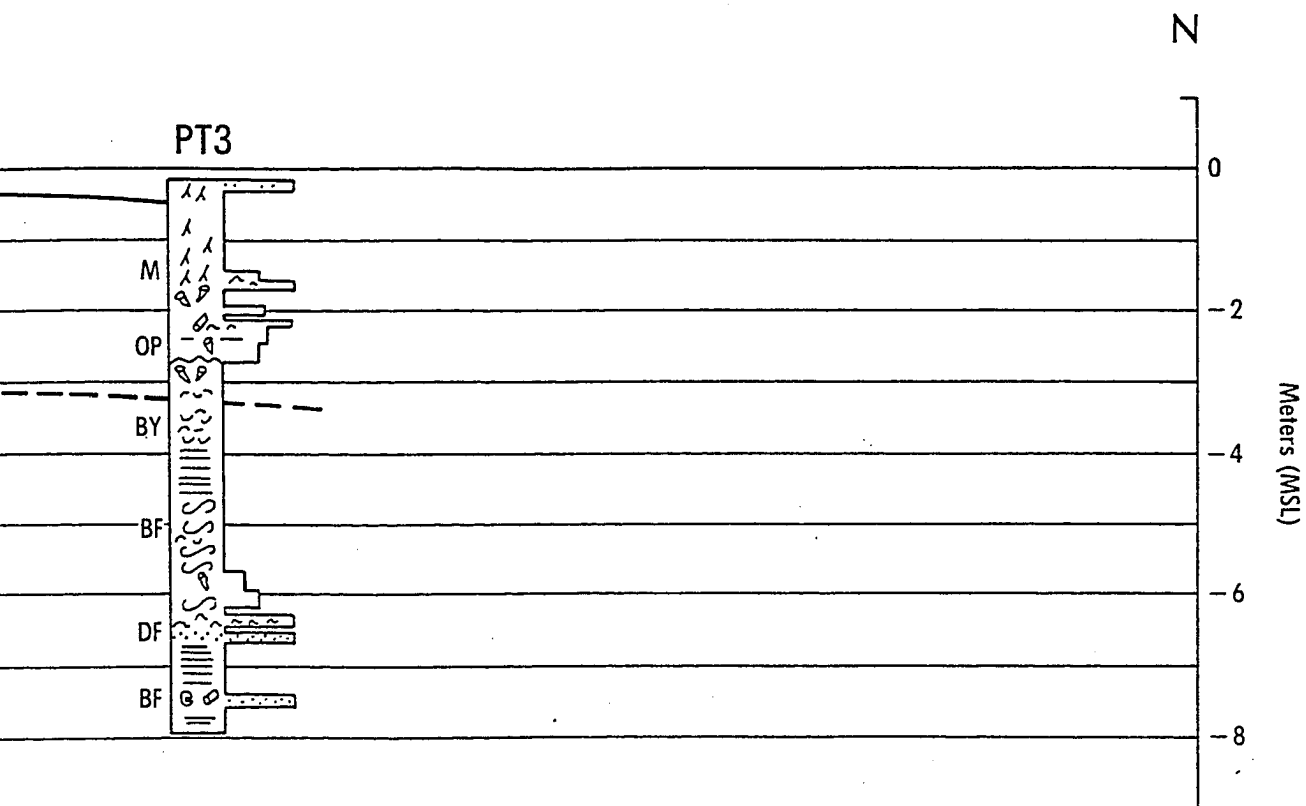


Figure 87. Transect PAS-1 to PAT-3. BB-Re and MS-Re are separated by the Bayou Blue Transgression. A shell lag dated 3700 ybp, at -3.4 m helped to define this event stratigraphically.



~~~~~ Scoured Surface  
 ——— Contact  
 - - - - Low Confidence Contact

NOTE: Areas shaded with the same patterns are correlative

3. BB-Re and MS-Re are  
 gression. A shell lag dated  
 ine this event



date merely specifies that the bivalves were alive at that time.

BB-Tr is part of a ravinement surface. Based upon the dip section between PAE and C-C' it would be difficult to interpret this as other than a bay ravinement. The faunal content of the dated material may also be used to interpret this as part of a transgressed bay environment. The entire sample consisted of disarticulated Rangia cuneata valves. If this were a true shoreface a more mixed faunal community including salt-tolerant species would be expected. The older shell material sits stratigraphically higher than delta plain marsh from core PAE-2/3 (Figure 83) dated 1970 ybp. The shells may have come from F-Re which is exposed in the offshore (Figure 84).

#### Transect PAW/PAS / Parasequence Ms-Re

**Description:** Parasequence Ms-Re is identified throughout Grande Terre spit at depths between -3.2 and -1.0 m. In core PAW-1 the ravinement surface at -3.2 m is overlain by horizontally bedded sands containing mud rip-up clasts (Figure 85). These sands are overlain by 1 m of shelly sands that became vegetated with Spartina alterniflora at -1.2 m. The horizontally-bedded shelly sands in cores PAW-2 grade to a distinct suite of three graded overbank units between -2.4 and -1.2 m. The sands at the base of these units are ripple-bedded and immature. A sandy unit

containing moderate to abundant shell fragments is intercalated with organic clays in core PAW-3. In core PAS-1, (-3.4 to -0.6 m) parasequence Ms-Re, bayfill muds coarsen to immature sands containing wood debris (Figure 87). This meter-thick channel sand grades to lightly rooted clays. In core PAT-3 (-3.4 to -0.5 m) proximal overbank facies grade to marsh. Deposition related to active channel facies in core PAS-2 between -3.2 and -1.8 m (Figure 86) is correlated to core PAW-1.

**Interpretation:** The coarser shelly sands in transect PAW are probably remnants of a beach ridge plain that built westward from an abandoned distributary. To the east in cores PAS-1 and PAS-2 the quartzose shelly sands are intermingled with overbank deposits suggesting that the old channel may have been located in the Pass Abel region.

#### **Transect PAW/PAS / Parasequence Md-Tr**

**Description:** Carbon-14 dates of the grassy material above the shelly sands in core PAW-1 (-3 to -2 m) revealed that they were modern (<100 ybp) (Figure 85). Above the rooted stratum lies backshore facies (PAW-1, -1.0 to 0.0 m) and foreshore (PAW-1, -1.0 to +0.4 m). A similar sequence of facies lies above Ms-Re in core PAW-2 (-1.4 to +0.6 m). In core PAW-3 parasequence Md-Tr consists of shelly bay clays. In strike section, parasequence Md-Tr extends from the eastern edge of Grande Terre spit (as defined by core PAS-1) to PAW-1 between -1.2 and +0.5 m.

**Interpretation:** Parasequence Md-Tr represents the most recent transgression occurring along the Grande Terre shoreline. Sands eroded from old beach ridges of the Ms-Re are being transported landward. The marsh, dated as modern, separates the older strandplain ridges from the landward transported foreshore sands.

## 6. QUATRE BAYOU PASS STRATIGRAPHY

### DATA DESCRIPTION

Four profiles containing sixteen vibracores were sampled from the Quatre Bayou Pass area (Figure 88). Transect QBP-B sampled the eastern fringe of the Barataria Headland. Transect QBP-C follows a relict levee system while QBP-D defines the landform that separates Quatre Bayou Pass from Pass Ronquille. Transect QBP-S is a strike section across the pass opening. Cores were taken on either side of the deep, narrow channel thalweg which is over ten meters deep. The vibracore equipment employed in this program could not obtain samples in water depths greater than two meters.

### Transect QBP-B Description and Interpretation

#### Transect QBP-B / Parasequence BB-Re

**Description:** Parasequence BB-Re ranges from -7.5 to -5.5 m in cores B-1 through B-5 (Figure 89) although it may extend below the cored depth limit. This parasequence contains proximal overbank units in core B-2 beneath -7 m and a 50-cm-thick overbank/crevasse splay in core B-3 between -6.0 and -5.5 m. The latter unit is overlain by root-disrupted laminated clays. Further landward in cores B-4 and B-5 parasequence BB-Re is represented by marsh and laminated clays with moderate rooting, respectively. In cores B-1 through B-4 the top of BB-Re is marked by a scoured surface

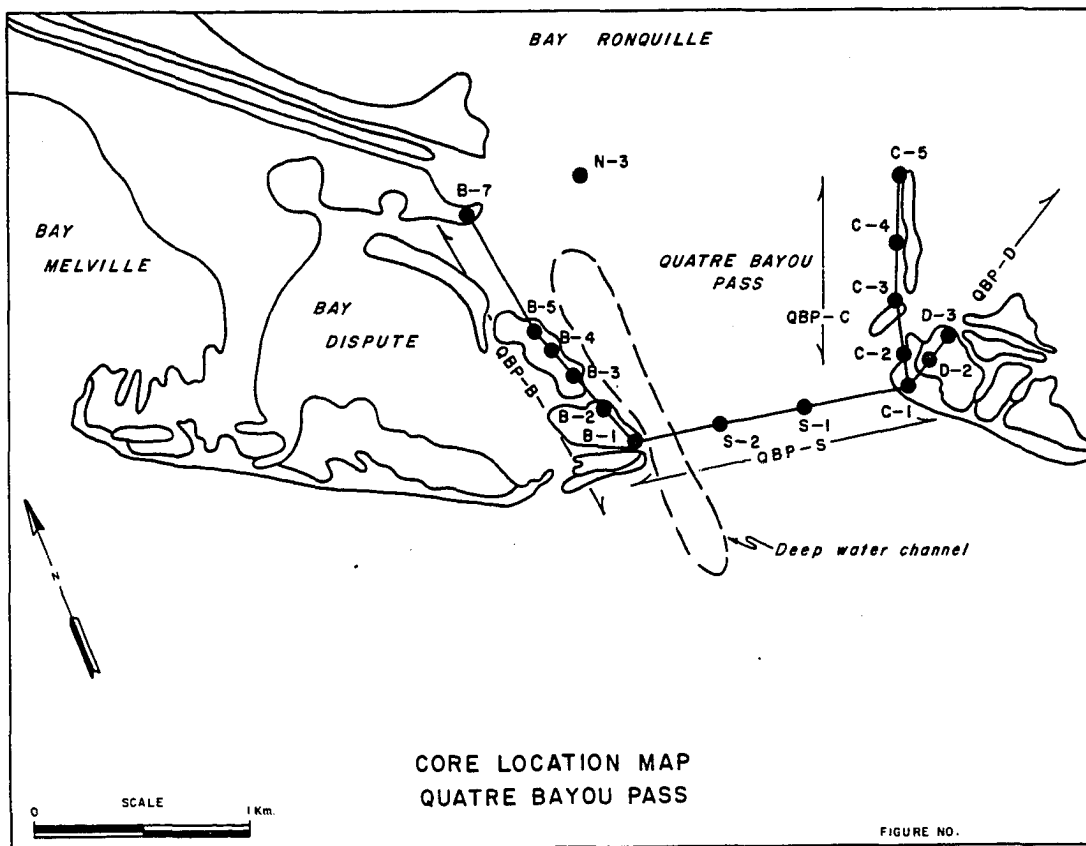


Figure 88. Location of cores taken in Quatre Bayou Pass area.



## CROSS SECTION QBP-B

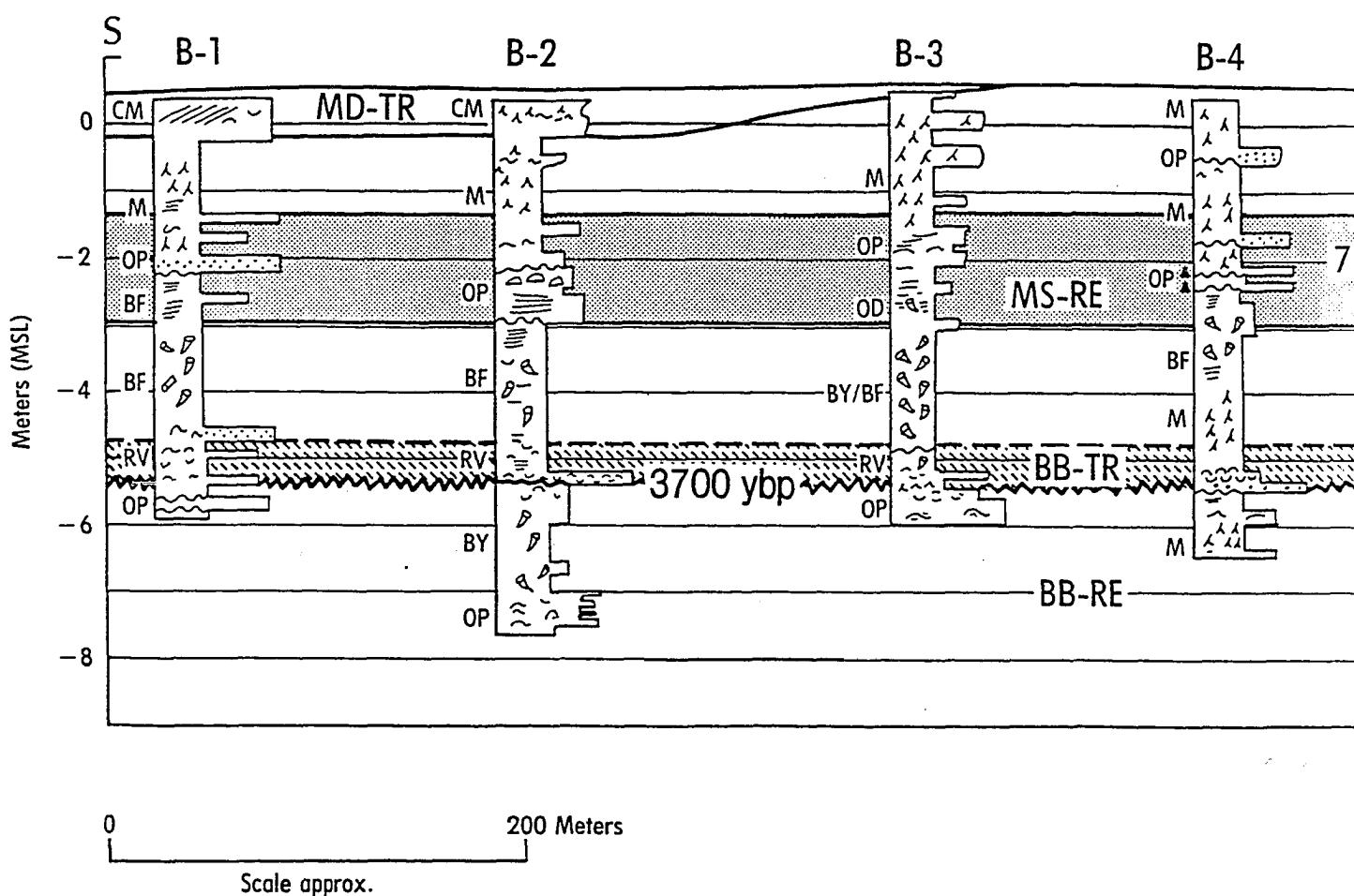
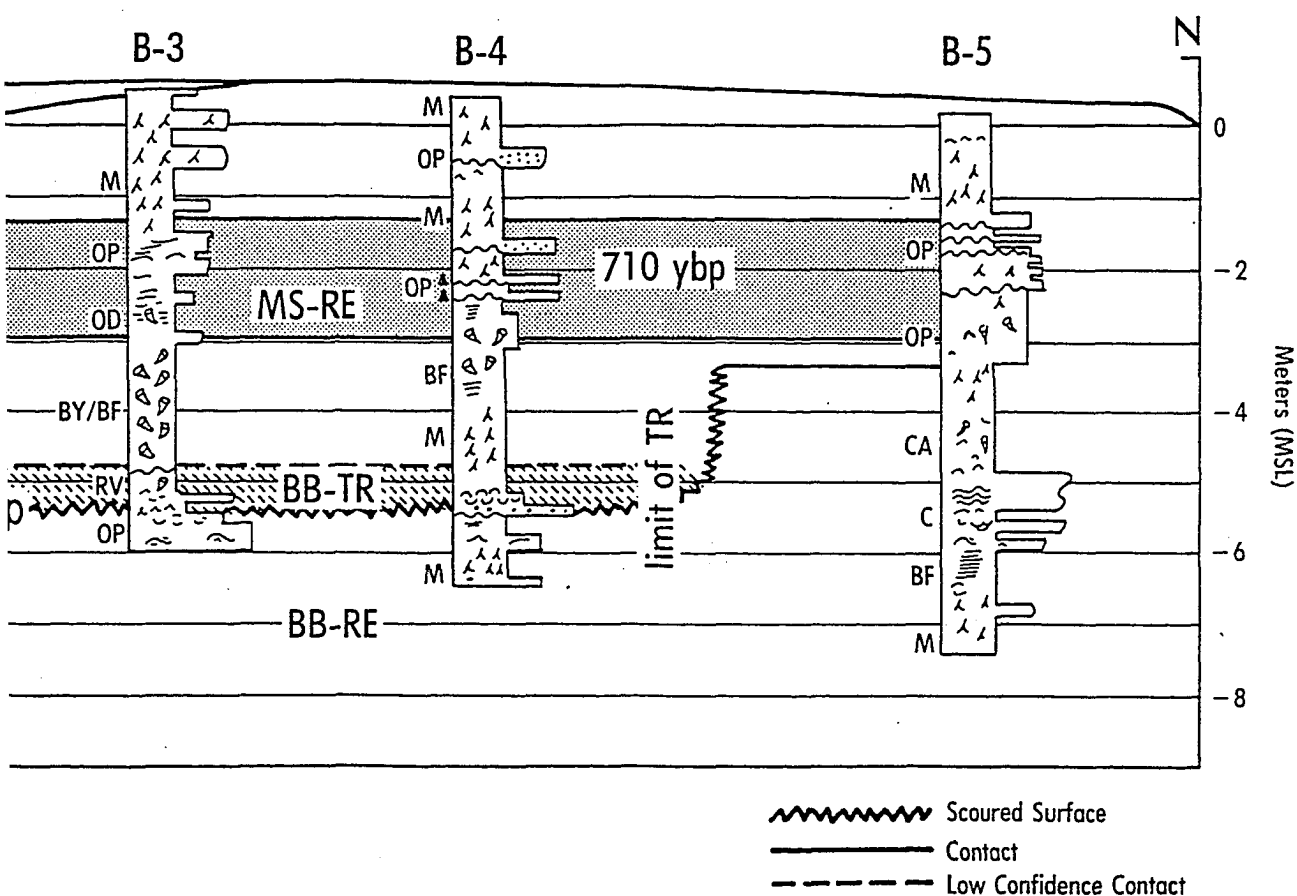


Figure 89. Transect QBP-B. In core B-2, a transgressive shell lag dated 3700 ybp separates BB-Re and Ms-Re. The landward limit of this transgression is located between cor B-4 and B-5. A C-14 date acquired from in-situ vegetation in core B-4 shows that the Ms-Re Progradation occurred around 700 ybp.





. In core B-2, a transgressive separates BB-Re and Ms-Re. The ansgression is located between core acquired from in-situ vegetation in s-Re Progradation occurred around



at approximately -5.5 m. In core B-5 the contact between BB-Re and Ms-Re is transitional.

In core B-5, parasequence BB-Re, between -6.5 and -3.0 m, bayfill muds grade to delta front and active channel deposits. Once abandoned, the channel filled with burrowed shelly muds and then marsh near -3.2 m.

**Interpretation:** Parasequence BB-Re represents the regressive phase of a past delta lobe. The presence of marsh and overbank units within this section of the transect indicates that the main channel was in the general vicinity, perhaps located in the present channel location of Quatre Bayou Pass. An explanation regarding the difference in BB-Re thickness seaward of core B-4 and those landward is offered as part of the interpretation of the overlying parasequence BB-Tr.

#### **Transect OBP-B / Parasequence BB-Tr**

**Description:** Parasequence BB-Re is truncated in cores B-1 through B-4 by parasequence BB-Tr. In core B-2 at -5.1 m a sandy unit containing large fragments of Crassostrea virginica and Thais hemastoma lie over interdistributary bay facies. The shelly material was radiocarbon dated at 3730 +/- 110 years. This debris was transported and does not indicate the relative age of the stratum it was deposited in. This sandsheet, observed in cores B-1, B-3 and B-4, disappears between B-4 and B-5. BB-Tr is buried

beneath the bay fill of the subsequent delta lobe.

**Interpretation:** Parasequence BB-Tr is a ravinement surface formed during the abandonment phase of delta lobe BB-Re. The discrepancy between the thickness of BB-Re in cores B-4 and B-5 is directly related to the post BB-Re transgression. The landward limit of shoreface erosion occurring during this time period is between B-4 and B-5. The fossil debris found within the sandsheet in cores B-1 through B-4 (-5.2 and 4.8 m) are remnants of salinity tolerant fauna. Even though the fossil evidence suggests that marine influences were nearby, this ravinement occurs at a depth only 4 meters shallower than the present depth limit of shoreface. The offshore transect B-B' also shows the BB-Tr surface at this approximate depth. If this were a true shoreface ravinement the contact 1 kilometer offshore would be deeper than it is observed. Based upon this evidence BB-Tr is a bay ravinement surface. The true shoreface of BB-Tr was probably located several kilometers offshore. The faunal content of this unit suggests that marine influences were nearby. This observation, combined with its shallow occurrence suggests that a barrier shoreline complex was close by.

#### **Transect OBP-B / Parasequence Ms-Re**

**Description:** Parasequence Ms-Re dominates this transect above -5m seaward of core B-4 and above -3.4 m landward of it. In cores B-1 through B-4 Ms-Re has buried the ravinement surface of BB-Tr. In cores B-5 and B-7 there is

a transitional contact between the upper portion of delta BB-Re and the bay fill units of Ms-Re. Laminated bayfill muds which generally lie at -4.8 m, coarsen to delta front sands at the base of Ms-Re in cores B-1 through B-4 near - 2.8 m. A thin stratum of gray, immature sands located in cores B-1 through B-5 between -2.5 and -1.5 m is an indicator that the main channel was nearby. In-situ woody roots buried by the sands were extracted from core B-4 (-2.2 m) for radiocarbon dating. The C-14 date for these roots was 710 +/- 350 ybp. The large standard error was reported due to the small sample size. Delta plain marsh is ubiquitous in this parasequence above -1.5 m. Interpretation: Parasequence Ms-Re records the last regression occurring in this region about 700 years ago.

Transect OBP-B / Parasequence Md-Tr

Description: There is a sharp contact at -0.2 m between the upper marsh of Ms-Re and shelly sands of Md-Tr in cores B-1 and B-2. Md-Tr is largely subaerial and is not observed landward of core B-2. In core B-1 bedding is inclined slightly and burrowing is not observed. Landward, sands in core B-2 contain some shell material as well as Spartina alterniflora roots.

Interpretation: Parasequence Md-Tr represents the present transgression over Ms-Re. In core B-1 the foreshore sands accumulate with successive overwash of Gulf waves. The sands in B-2 are deposited while water levels in Bay Ronquille

are elevated. Elevated water levels may occur as a result of seasonal flooding or storm surge.

### **Transect QBP-S Description and Interpretation**

#### **Transect QBP-S / Parasequence BB-Re**

**Description:** Cores S-1, S-2 and C-1 all penetrated to depths greater than -6m (Figure 90). Between -7.5 m and -6 m lie a packet of regressive facies. In core S-2 a two-meter unit of laminated clays grade to delta front and then active channel sands. These sands, located between -6.5 and -6.0 m, are immature. The various hues of heavy minerals within the sands allowed trough cross-bedding to be observed in core. Core S-1, positioned approximately 0.4 km to the east of core S-2, contained three graded units between -7 and -6 m. In core C-1, further to the east, this depth interval exhibited laminated and burrowed bayfill muds. There is a sharp, eroded contact above the sands in core S-2 that can be traced eastward across the transect. This is considered the upper contact of BB-Re.

**Interpretation:** Parasequence BB-Re describes part of a prograded delta lobe. The reduction in sand percentage from west to east is an indicator that an associated distributary was located in the same position as the present Quatre Bayou Pass.



## CROSS SECTION QBP-S

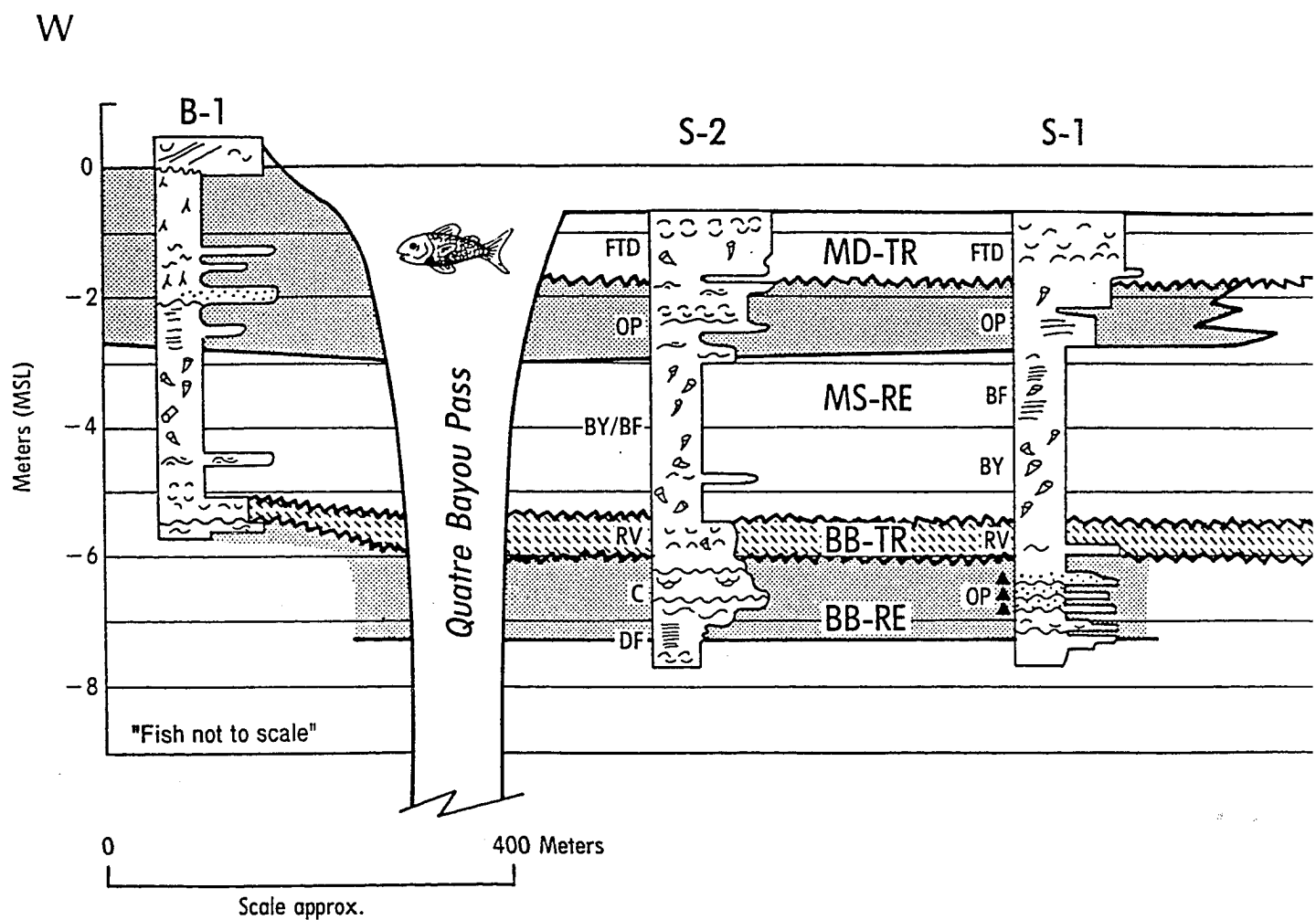
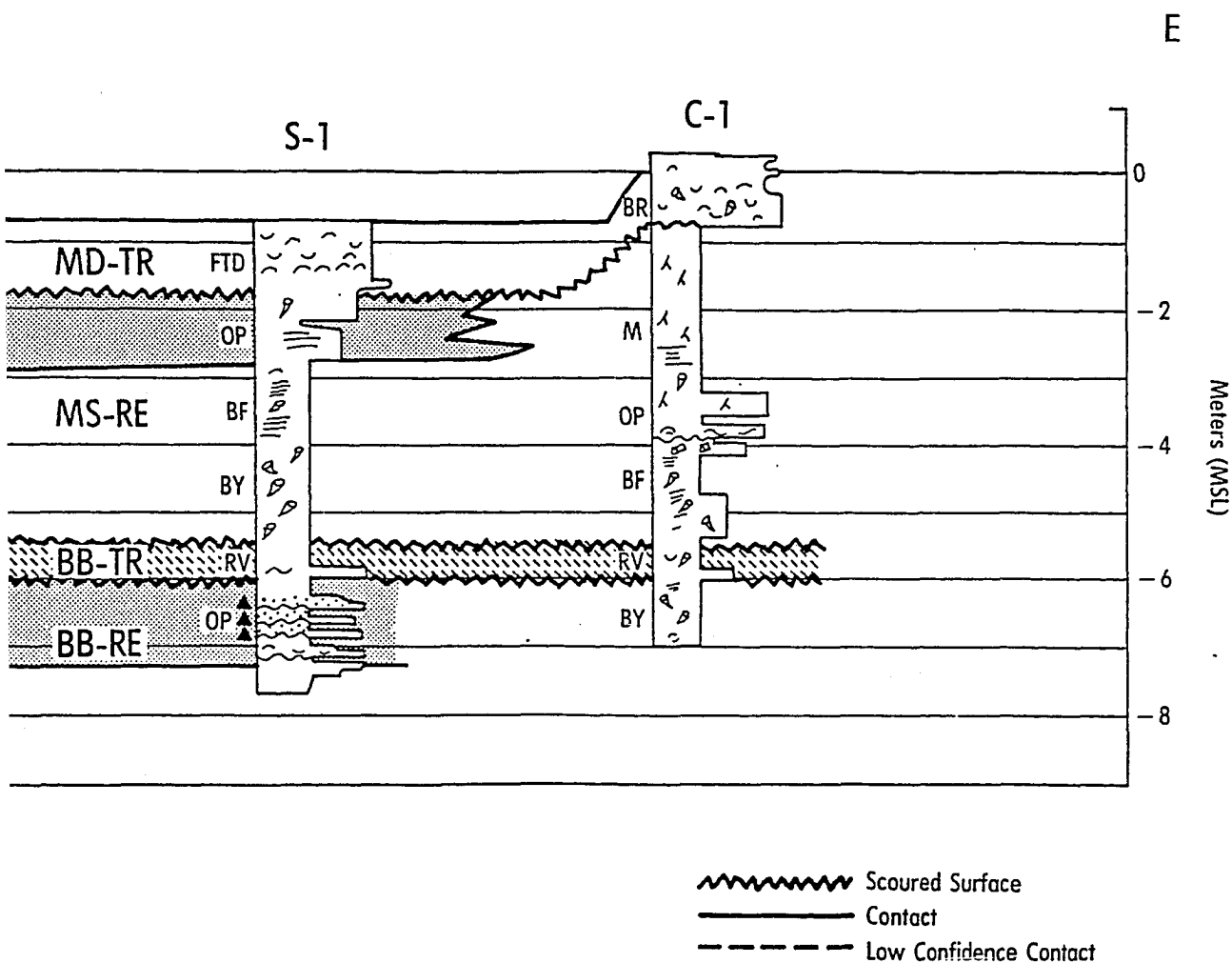


Figure 90. Transect QBP-S. Diminishing bed shear is noted distally from the Quatre Bayou Pass channel in sequence BF Re. This is evidence that a Bayou Blue distributary channel flowed through the present channel location.





Diminishing bed shear is noted  
 Bayou Pass channel in sequence BB-  
 a Bayou Blue distributary channel  
 channel location.



**Transect OBP-S / Parasequence BB-Tr**

**Description:** A 0.5-m-thick unit of shelly sands in core S-2 between -6 and -5.5 m has a sharp basal contact. This unit lies on top of a surface that has eroded into the underlying channel unit of BB-Re. A thin stratum of shelly sands at -5.5 m in core C-1 may be correlated with the thicker shelly sandy unit located in core S-2. A decimeter-thick unit of bedded sands in core S-1 at -6.0 m does not contain shell material but is equated stratigraphically with the coarse strata at the same elevation in cores S-2 and C-1.

**Interpretation:** Parasequence BB-Tr is the transgressive component of the underlying delta lobe. The most convincing evidence supporting this conclusion is found in core S-2 where there is an abrupt change from distributary channel sands to sands containing remains of brackish to saline tolerant fauna.

**Transect OBP-S / Parasequence Ms-Re**

**Description:** In transect OBP-S, parasequence Ms-Re is the thickest in core C-1. Burrowed, shelly bay muds of BB-Tr in core C-1 (-6.0 to -5.5 m) are buried by laminated bay fill muds between -5.5 and -4.0 m. The bay fill is overlain by delta front and active channel sands (-4.0 to -3.0 m). The channel sands are overlain by marsh between -3.0 and -0.75 m. To the east cores S-1, S-2 and B-1 contain

interdistributary bay muds and bay fill from -5 to -3 m. Overbank deposits of Ms-Re flank the present channel location from -3.0 to -1.8 m. In core B-1 where they are seen between -2.5 and -1.0 m.

**Interpretation:** Parasequence Ms-Re describes a phased delta lobe progradation. The deeper channel located in core C-1 probably preceded the one responsible for the overbank deposits flanking the present western channel. It is hypothesized that levee failure upstream of the established eastern channel caused the distributary flow to switch to a more westerly channel location.

#### **Transect QBP-S / Parasequence Md-Tr**

**Description:** Parasequence Md-Tr caps the entire QBP-S section between -2.0 m and the present surface. It is thinner on the channel margins. This parasequence is significantly coarser than underlying units and contains moderate to heavy concentrations of shell fragments.

**Interpretation:** Parasequence Md-Tr represents an influx of marine sediments into the Quatre Bayou Pass area within the past hundred years. The meter thick shelly sands within the pass opening have been deposited by both wave processes and tidal currents. The concentrations of modern sands on the beaches adjacent to Quatre Bayou (Cores B-1 and C-1) are primarily the result of washover events.

## **Transect QBP-C Description and Interpretation**

### **Transect QBP-C / Parasequence BB-Re**

**Description:** Cores C-4 and C-5 sampled delta plain marsh between -7.5 and -6 m (Figure 91). These were the only cores in this transect that penetrated this sequence.

**Interpretation:** The delta plain marsh marks the top of the Bayou Blue delta lobe progradation. The difference in elevation between C-4 and C-5 is likely the result of the ensuing transgression.

### **Transect QBP-C / Parasequence BB-Tr**

**Description:** The delta plain marsh of BB-Re is overlain in C-4 and C-5 by bay muds that contain moderate to heavy shell concentrations. Shell hash was sampled in core C-3, between -6.7 and -6.4. The fauna represented in the hash includes Thais hemastoma, Crassostrea virginica, and Rangia cuneata.

**Interpretation:** The coarse unit of shells sampled in core C-3 is part of a flood-tidal delta. The intrinsic characteristics of this deposit are identical to those found in the modern flood delta located within Pass Abel. BB-Tr contains components of a barrier shoreline that built during the abandonment phase of the BB progradation.

### **Transect QBP-C / Parasequence Ms-Re**

**Description:** The bulk of transect QBP-C is made up of parasequence Ms-Re. Laminated bay fill clays are located

## CROSS SECTION QBP-C

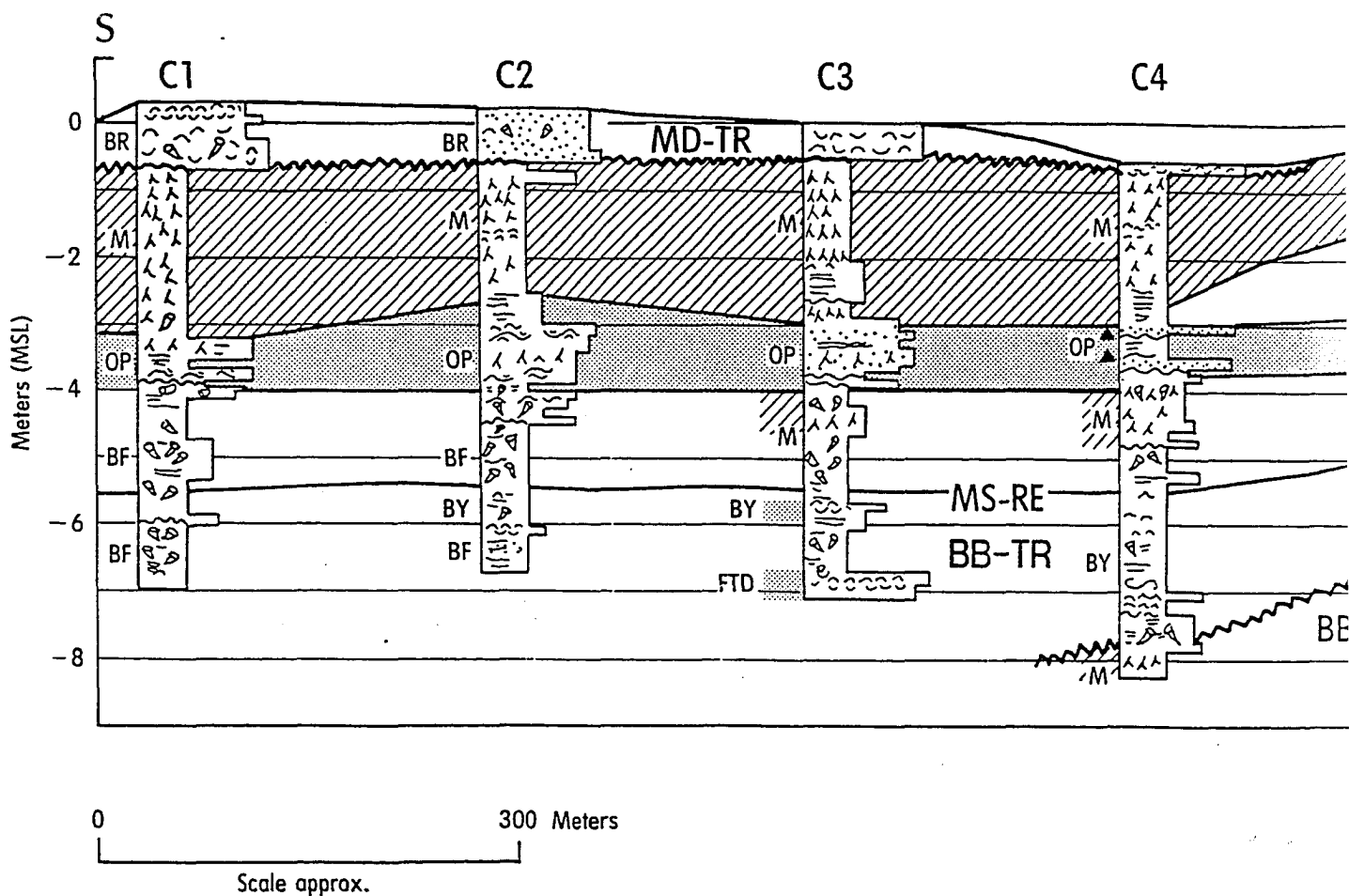
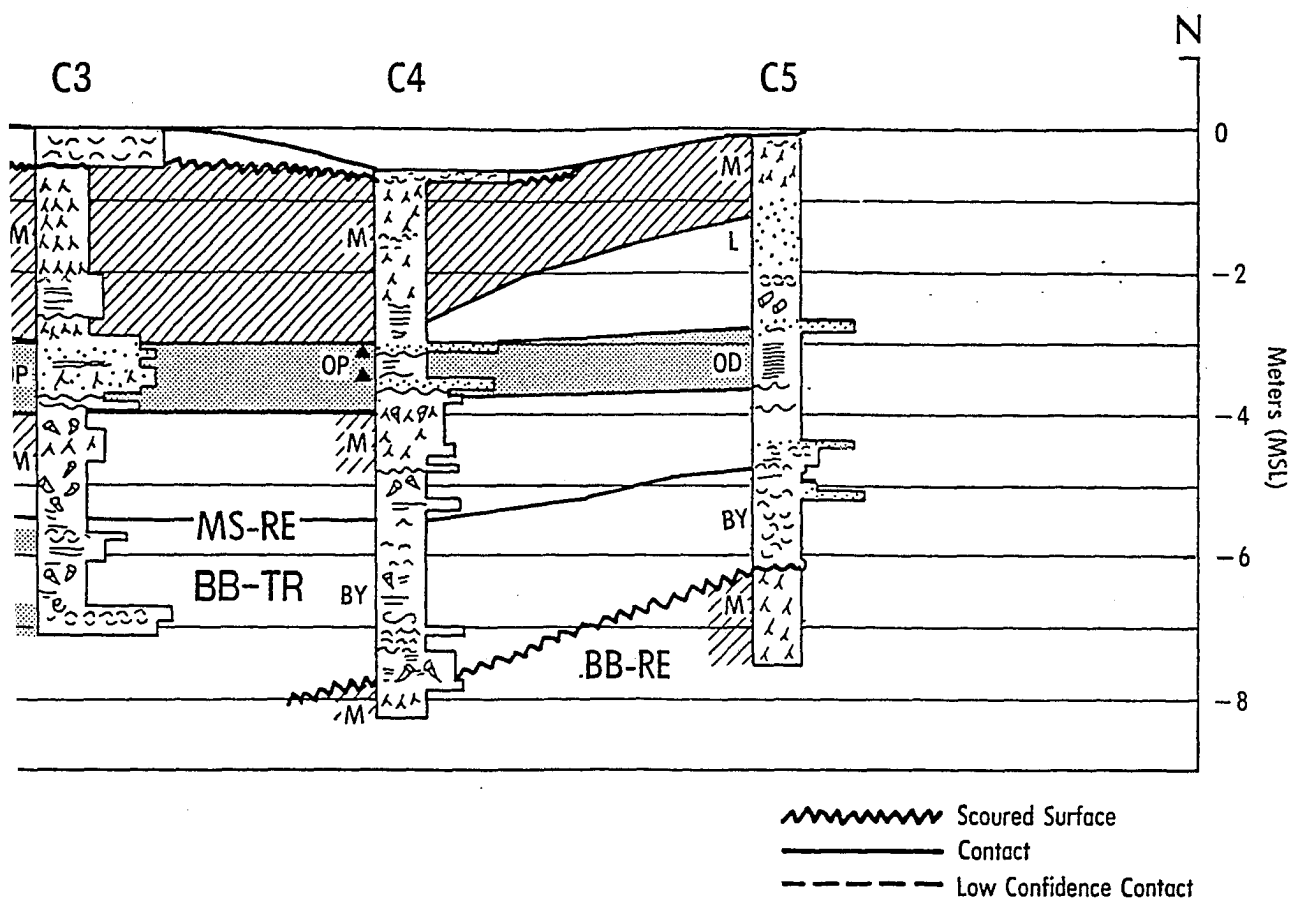


Figure 91. Transect QBP-C. The Bayou Blue progradation (BB-Re) is encountered deep in cores C-4 and C-5.







Bayou Blue progradation (BB-  
s C-4 and C-5.



between -5.2 and -4.0 meters in cores C-1 through C-5. In cores C-3 through C-5 the bay clays are lightly rooted. At approximately -4.0 m an erosional contact precedes a coarsening upward sequence. Climbing ripples within the sands of core C-2 are evidence of high sedimentation rates. However, intermittent lenses of roots within the coarser units suggest that the flow was ephemeral and the surface sometimes emergent. Between -3.0 m and - 0.5 m the coarser unit fines to laminated muds and then to marsh.

**Interpretation:** Parasequence Ms-Re contains facies that are consistent with the portion of a subdelta that lies adjacent to a main distributary channel.

**Transect OBP-C / Parasequence Md-Tr**

**Description:** There is an abrupt change in lithology at -0.5 m in transect C. The fine-grained delta plain marsh of parasequence Ms-Re is contacted sharply by transgressive sands. In cores C-1 and C-2 between -0.5 and +0.7 m Md-Tr is comprised of burrowed, shelly foreshore and backshore sands, respectively. In cores C-3 and C-4 the surficial sediments are also predominantly sands with a heavy shell content.

**Interpretation:** The foreshore and backshore sands in cores C-1 and C-2 are eroded from the gulf- side shoreline and transported landward during washover events. The coarse material at the top of cores C-3 and C-4 represent the

present Ronquille Bay floor. Core C-5 is further landward and has not yet received the coarse transgressive material. However, the delta plain marsh in core C-5 lies just below sea level and has recently succumbed to relative sea level rise. It is now covered beneath bay muds.

#### **Transect QBP-D Description and Interpretation**

##### **Transect QBP-D / Parasequence BB-Tr**

**Description:** Core D-2 penetrates significantly deeper than other cores in this transect (Figure 92). Between -7.2 and -5.0 m there is a sequence of stacked washover sands capped by rooted muds.

**Interpretation:** This unit represents a barrier flanking an eroded headland.

##### **Transect QBP-D / Parasequence Ms-Re**

**Description:** In all three cores in this transect progradational facies are prevalent between -5 and 2 m, becoming aggradational to the surface. Laminated bayfill muds coarsen to proximal overbank deposits. In core C-1 a sharp erosional contact at -3.0 m identifies where a crevasse channel has scoured into the underlying facies. The coarser facies fine upward to lightly rooted clays and then marsh.

**Interpretation:** Parasequence Ms-Re represents a levee sequence that lies adjacent to a distributary channel. This transect follows the present eastern boundary to Quatre Bayou Pass.

## CROSS SECTION QBP-D

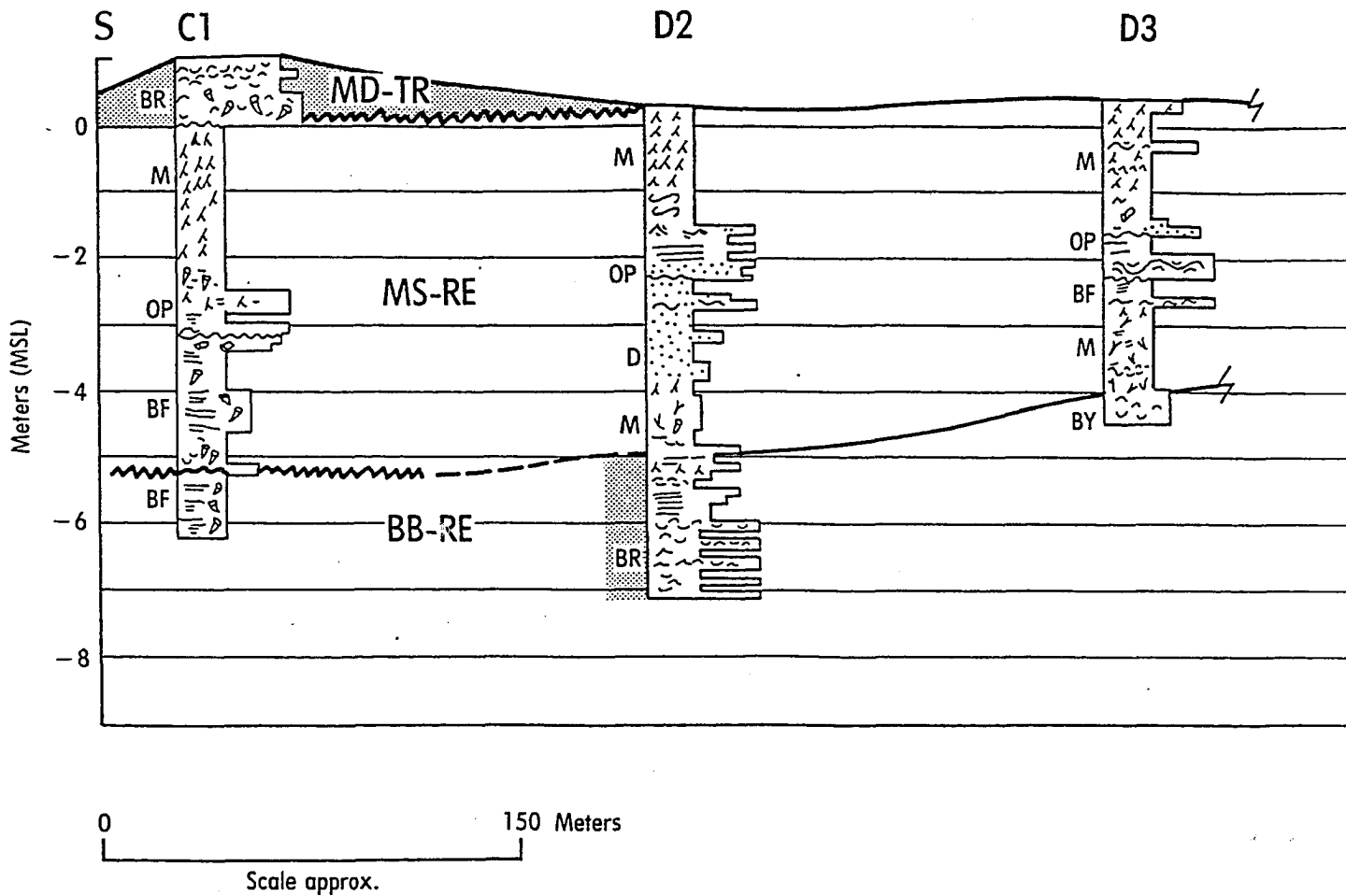
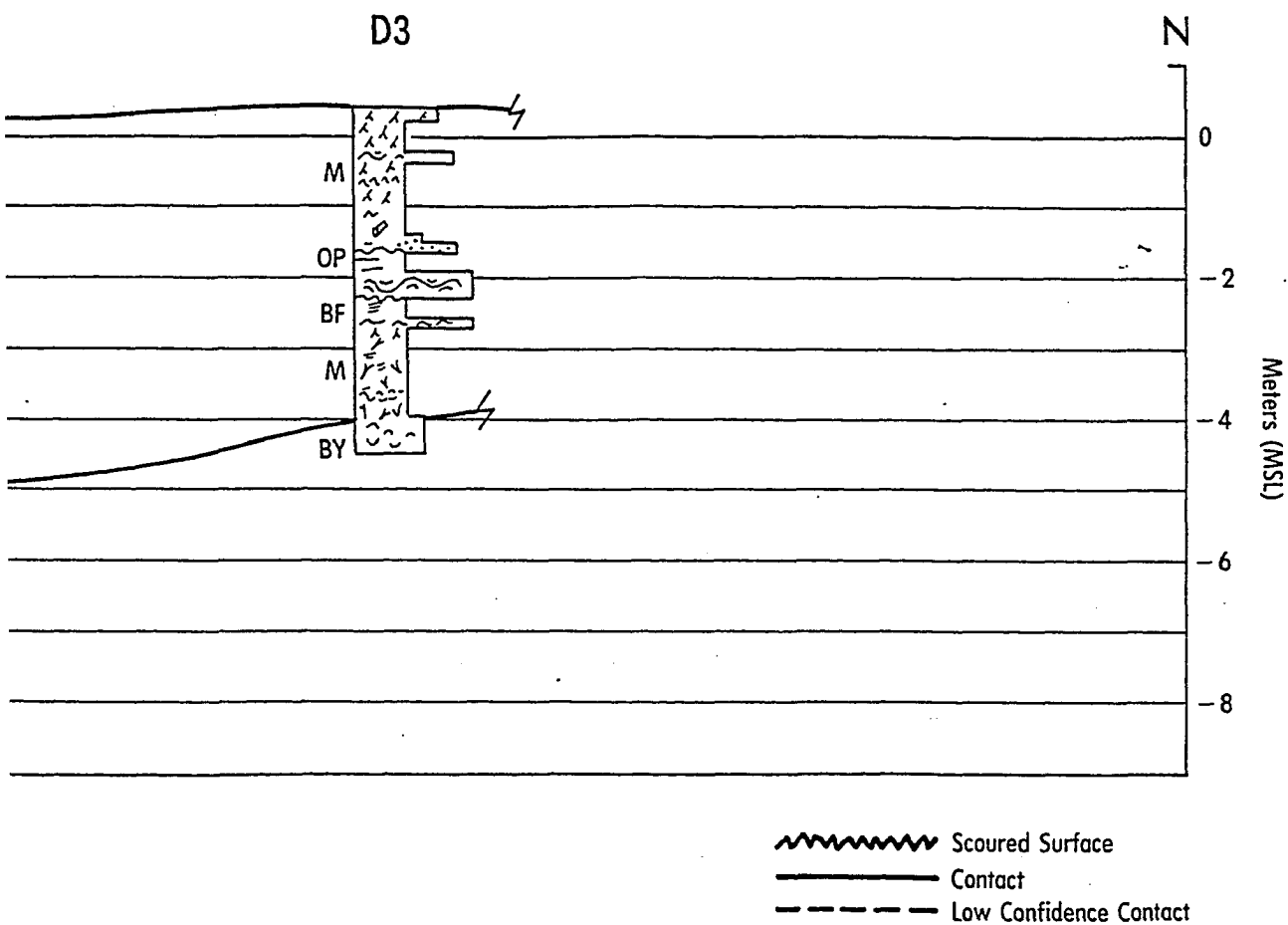


Figure 92. Transect QBP-D. The intercalated beds of shells and sands in sequence BB-Re are part of the transgressive component of the Bayou Blue delta lobe.





intercalated beds of shells  
part of the transgressive  
lobe.

NOTE: Areas shaded with the  
same patterns are correlative





**Transect OBP-D / Parasequence Md-Tr**

**Description:** Core C-1 is a "cornerstone" core for transects QBP-C and QBP-D. As previously discussed the interval of core C-1 between 0.0 and +0.7 m consists of burrowed shelly sands that coarsen upward. Within ten centimeters of the core surface the burrows decrease and shell content increases.

**Interpretation:** Parasequence Md-Tr is the foreshore component of a barrier beach. The sands have either been transported alongshore or landward from the eroding shoreface, or both. Conclusively the environment of deposition is transgressive.

## 7. PASS RONQUILLE STRATIGRAPHY

### DATA DESCRIPTION

Twenty-six vibracores were retrieved from four transects within the Pass Ronquille area (Figure 93). Transect 'CRC' runs along the western pass boundary, from foreshore to backshore across the marsh and into the channel that connects Bay Long and Bay Ronquille. Transect 'CR' traverses northward from Point Chenier Ronquille across the Bay Long channel opening. On the landward side of the channel this transect 'dog-legs' to the northwest across the middle Bay Long channel and through relic splay lobes. Transect 'CRD' parallels the gulfward portion of the pass opening while 'CRB' lies approximately 0.5 km to the north, crossing the flood tidal delta and two channels. (Cores CR-B-3 and CR-10 were misplaced in transit to the laboratory and never recovered).

### Transect CR-C Description and Interpretation

#### Transect CR-C / Parasequence BB-Tr

Description: Beneath interval -6.0 m in core C-6 fine sands grade to sandy silts (Figure 94). No shells or bedding were noted in the quartzose sands. A moderate concentration of shell fragments are mixed in sands below -6.0 m in cores C-3 and C-4. In C-4 the sands fine from 150  $\mu$  to 125  $\mu$  before grading to burrowed muds. The shell fragments represent Crassostrea virginica, Rangia cuneata

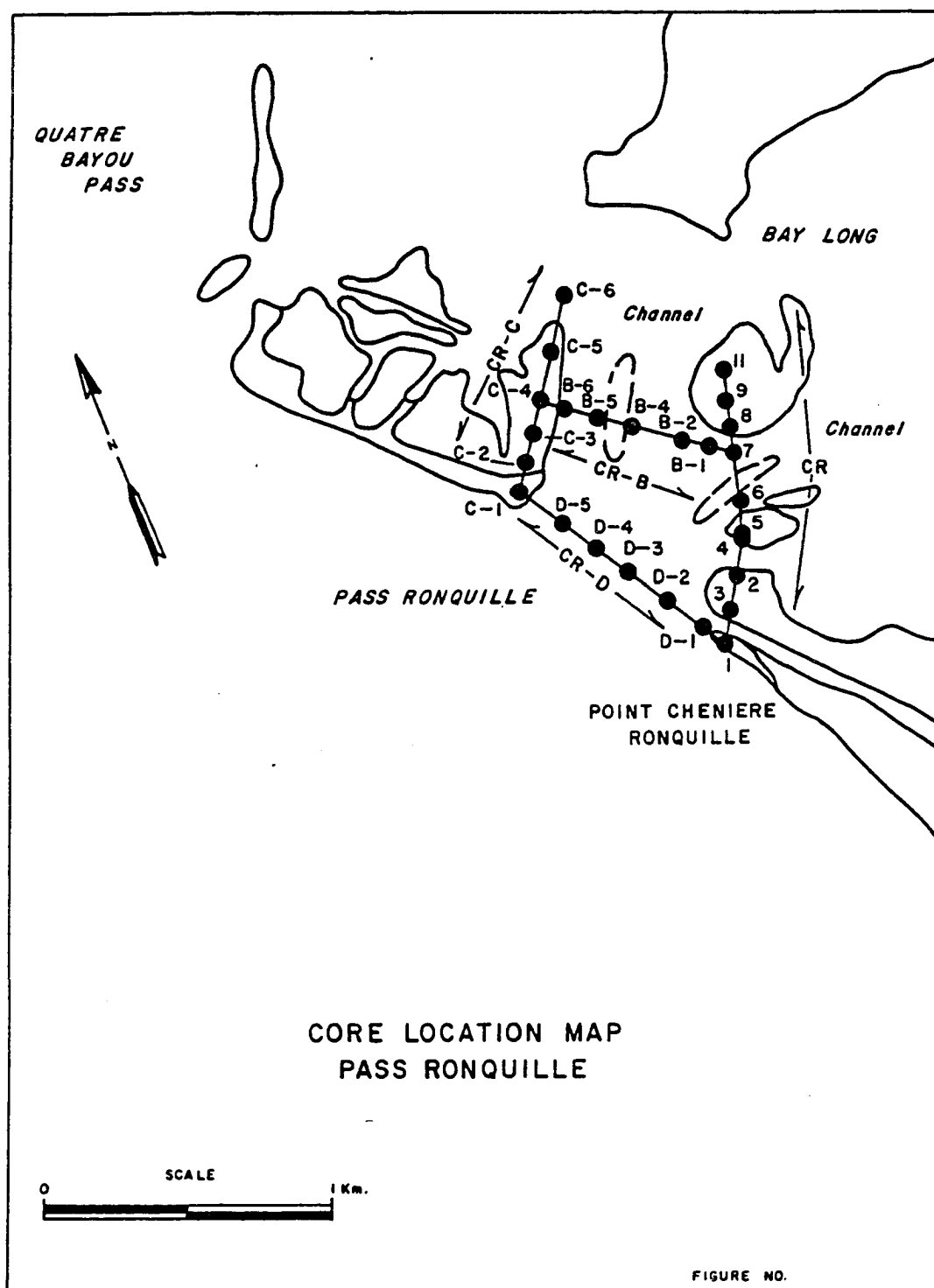


Figure 93. Location of cores taken in the Pass Ronquille area.

## CROSS SECTION CR-C

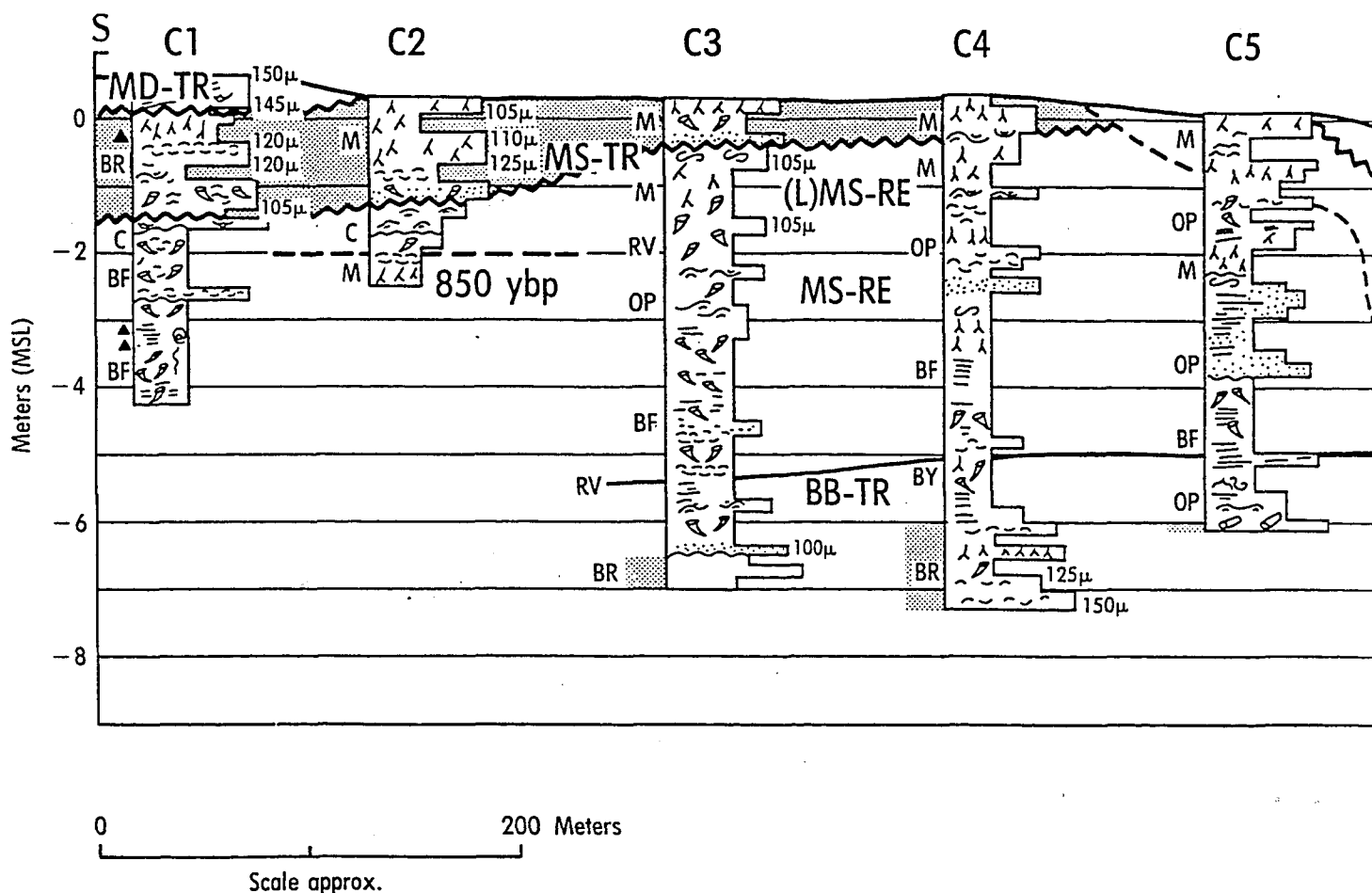
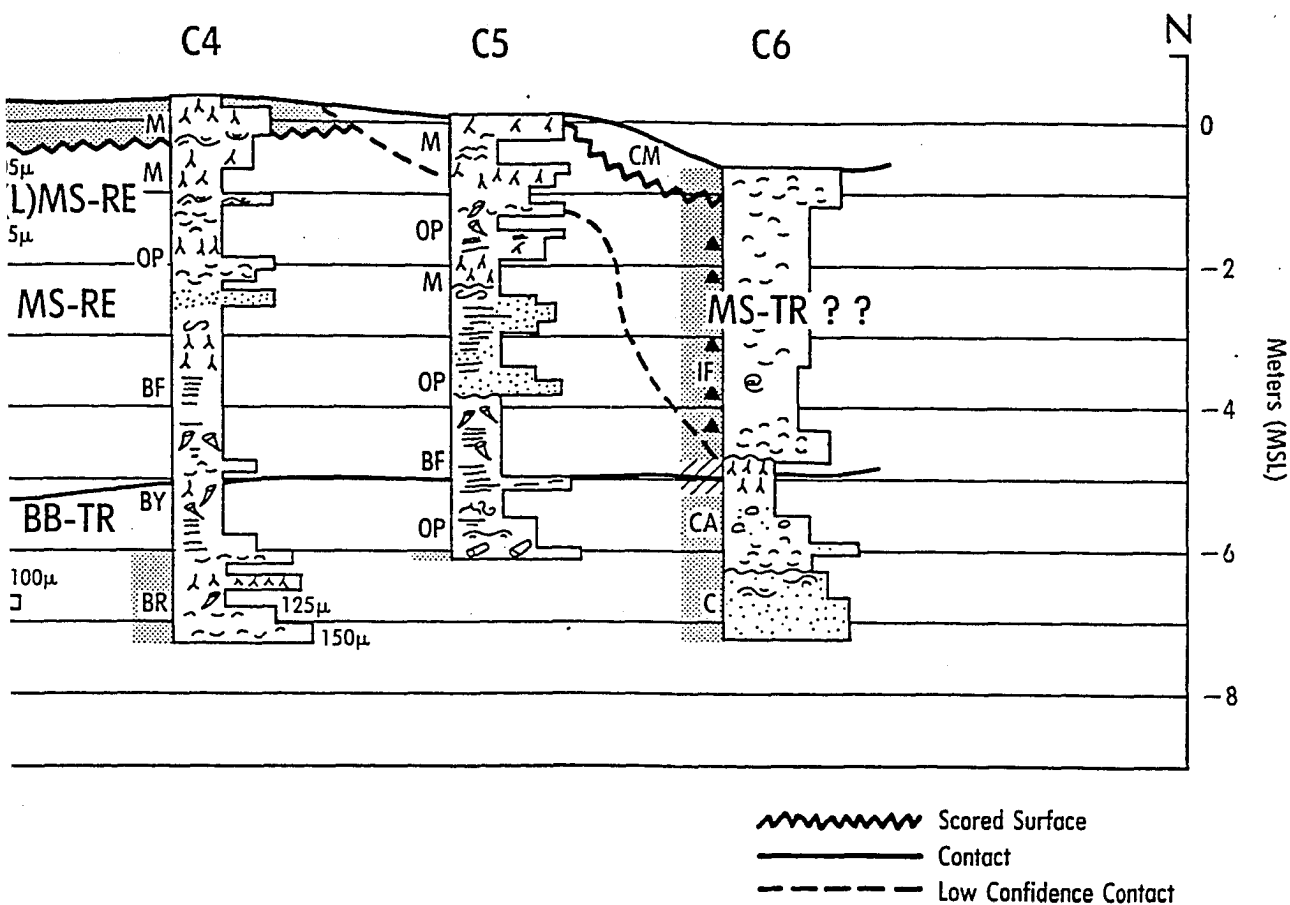


Figure 94. Transect CR-C. Sequence MS-Re is capped by another minor progradation designated (L) MS-Re-Re. In core C-6, Ms-Tr may be a tidal inlet fill from the Mississippi Transgression.





quence MS-Re is capped by  
designated (L) MS-Re-Re. In core  
let fill from the Mississippi





and unspecified gastropods. A similar suite of shells in a slightly finer matrix lies above the inlet channel sands of BB-Re in core C-6.

**Interpretation:** Immature, gray colored sands were frequently used to distinguish distributary sands from transgressive sands described in Barataria cores. Although the sands in core C-6 are free of shell debris they were classified as quartzose. The presence or absence of shell material does not preclude a channel sand from being classified as either marine or non-marine. However, quartzose sands are predominantly associated with inlet channels. The sands in C-6 are interpreted to be of inlet origin. Parasequence BB-Re represents a cross-section of inlet associated deposits. The inlet channel in core C-6 lies adjacent to a flood tidal delta exhibited by core C-4. Overall parasequence BB-Re represents the retrogradational phase of the delta lobe life-cycle. Sediments eroded from the delta lobe headland are deposited into a coast parallel beach ridge plain. Welder's landward packet of ridges (Figure 5) represents the BB-Re strandplain.

#### Transect CR-C / Parasequence Ms-Re

**Description:** Strata in parasequence Ms-Re generally alternate between laminated clays, light to moderately rooted clays and ripple-bedded silts. Core C-5 contains meter-thick units of ripple-bedded sands that fine upward to rooted clays between the interval of -5 and -2 m. The

varying lithology and thickness of these stacked units suggest that they lie near to a distributary channel. Roots extracted from -2.5 m in core C-2 and dated radiometrically date this progradation around 850 ybp. Sections of this parasequence below -4.0 m in core C-3 and C-4 and a thin stratum at -2.0 m in cores C-2 and C-4 contained light concentrations of Rangia cuneata. A twenty centimeter vertical escape structure lies below a Littorina sp. (snail), shell in core C-1 at -3.8 m. The snail was literally buried alive by bayfill muds.

**Interpretation:** Parasequence Ms-Re depicts a five meter thick portion of a prograded delta lobe. Bayfill facies are first noted at about -5.0 m. The disappearance of shells at -4.0 m indicates an increase in the rate of sedimentation. Alternating fine-grained laminations and rooted units above -4.0 suggests that the bayfill muds have become distal overbank deposits. Coarser proximal overbank deposition between -4 and -2 m in cores C-3 through C-5 suggests that the distributary channel was nearby. The shelly muds in core C-2 and C-4 at -2.0 may represent a bay ravinement surface between successive delta lobes.

#### Transect CR-C / Parasequence Ms-Tr

**Description:** The sedimentary characteristics between -4.0 and -0.5 m in core C-6 are considerably different than those found 75 meters to the south in core C-5. The base of parasequence Ms-Tr appears to have scoured into a marsh.

Core C-6, between -4.6 m and -0.5 m, is comprised of coarse graded units that range from 0.5 to 1.0 meters thick. Shell content increases higher in the unit.

Burrowed clays containing moderate shell concentrations are truncated and overlain by coarsening upward sandy sequences in cores C-1 and C-2, between -1.5 and +0.5 m. The sands increase in size from 105 u to 120 u in interval - 1.5 and -1.0 m. The sands contain a thin stratum of disarticulated Rangia cuneata valves and some woody organic debris. Near present sea level the sands are moderately to heavily rooted with Spartina alterniflora. The coarsening upward trend is noted in each core in this transect. It is dually noted that, although the lithology does coarsen, the relative thickness of this stratum decreases landward in cores C-3 and C-4.

Interpretation: In core C-6 parasequence Ms-Tr appears to be an active inlet channel fill. Based upon analysis of core C-5 and what has been interpreted as inlet fill in core C-6, it is concluded that the overbank units of C-5 were deposited when a distributary channel occupied the C-6 position. Following delta lobe abandonment the old distributary became a tidal inlet. On the Gulf-side of transect CR-C parasequence Ms-Tr exhibits a portion of a beach ridge that prograded laterally from an adjacent headland.

**Transect CR-C / Parasequence Md-Tr**

**Description:** The surface of core C-1 from 0.0 m to +0.5 m contains sands bedded at a slight incline. These sands coarsen slightly from 145 u to 150 u and contain no shells. The underlying unit is moderately rooted with Spartina sp.

**Interpretation:** Core C-1 was taken through a foreshore beach in a shoreline area that experiences a high rate of erosion. Sands eroded from seaward sources are transported landward with successive washover events. The sands in parasequence Md-Tr are considered part of an overall transgression.

**Transect CR-B Description and Interpretation****Transect CR-B / Parasequence BB-Tr**

**Description:** Interval -7.2 to -6.0 m in core C-4 contains shelly sands of a flood tidal delta (Figure 95).

**Interpretation:** This unit was interpreted to be a component of a flanking barrier shoreline. The abandoned BB-Re delta lobe was the source for the sediment.

**Transect CR-B / Parasequence Ms-Re**

**Description:** Parasequence Ms-Re contains coarsening upward lithologies between -5.5 and -2.0 m. The lightly burrowed laminated bayfill clays contain some detrital organics and a rare occurrence of a carbonate nodule. The sands in this

# CROSS SECTION CR-B

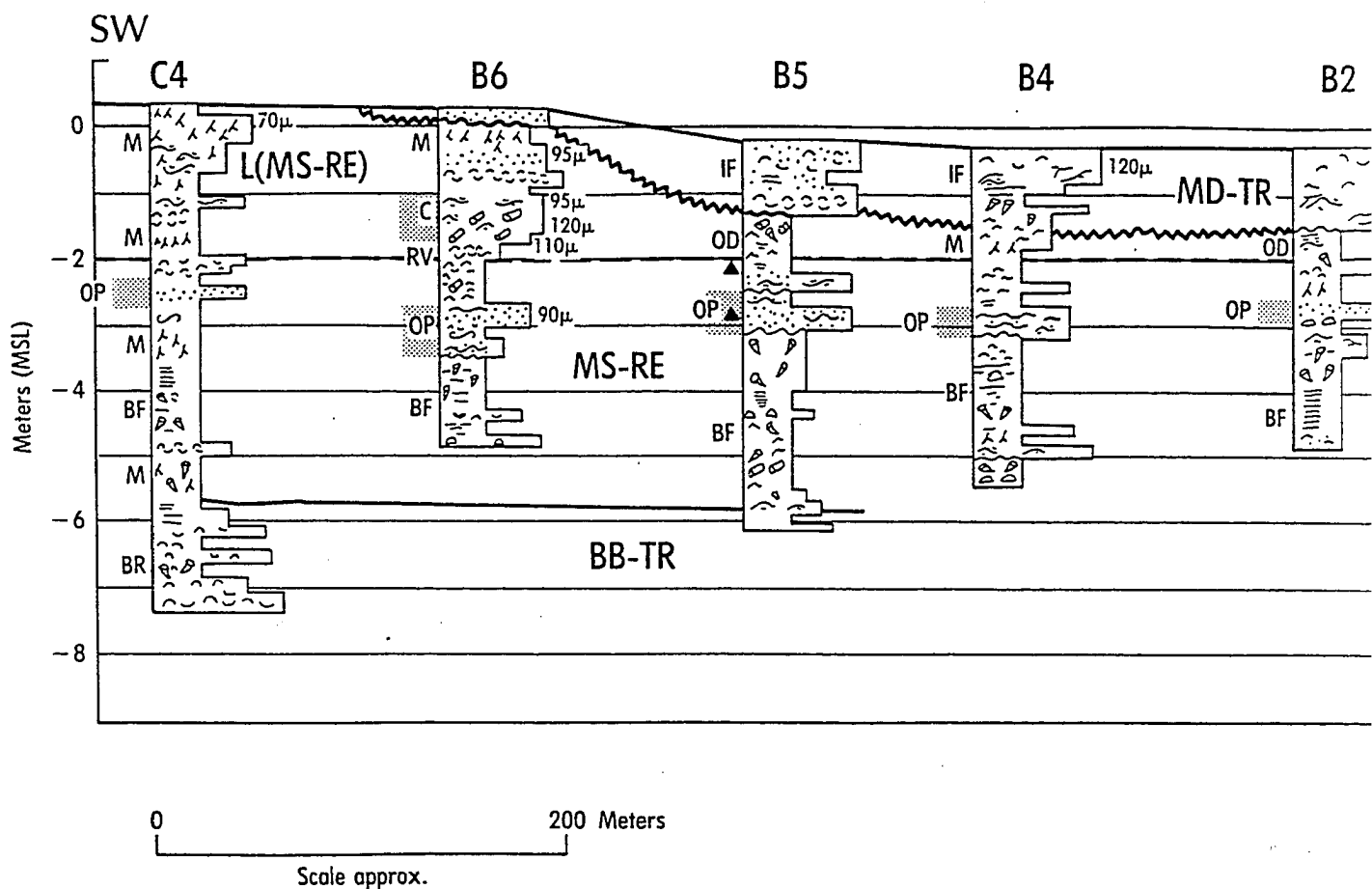
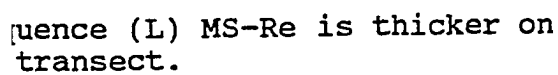


Figure 95. Transect CR-B. Sequence (L) MS-Re is thicker on either end of this east/west transect.









parasequence are located between -3.5 and - 2.0 m, have a mean grain size between 70 u and 90 u and grade to clays. Some of the clays contain light detrital organics and light to moderate rooting.

**Interpretation:** Parasequence Ms-Re is part of a prograded delta lobe. The lack of significant channel sands within this portion of the transect indicates that the main distributary channel was not sampled. The lightly rooted units are correlated to the dated unit located in core C-2 at -2.3 m. This information places the delta lobe construction prior to 850 ybp.

**Transect CR-B / Parasequence (Late) Ms-Re**

**Description:** A second, thinner, coarsening upward parasequence is located above Ms-Re beginning at interval -1.8m. This unit is thicker in the end cores, C-4 on the west and CR-7 on the east. The organic-rich surface sediments of parasequence Ms-Re are buried beneath laminated clays that grade to ripple-bedded sands containing woody detritus. The sands in B-6 coarsen from 110 u to 120 u before fining to 95 u. This coarser parasequence lies between -1.5 and -1.0 m. In core CR-7 a rooted stratum is buried by clays containing abundant disarticulated shells of Rangia cuneata. This facies is buried beneath ripple-bedded sands. This entire parasequence is located between -2.2 and -0.5 m. Bay fill laminated clays are noted in the central part of this parasequence between -2.2 m and -1.0 m.

**Interpretation:** Parasequence (Late) Ms-Re outlines the last delta sub-lobe to be deposited in the area. Its minimal thickness indicates that either this progradation was short-lived and had minimal areal impact or this transect was not aligned with the main distributary. The contact between the early Ms-Re and late MS-Re may be a bay ravinement.

**Transect CR-B / Parasequence Md-Tr**

**Description:** Bay fill clays and delta plain marsh in the central portion of transect CR-B have been buried beneath modern shelly sands above -1.0 m. In core B-4 the sands coarsen to 120  $\mu$  at the surface. The shells incorporated into the sands are a mix of Crassostrea virginica and Rangia cuneata. Minimal burrowing is observed in this interval. In core CR-7 through B-5 sands comprise the bottom of Bay Ronquille. In core B-6 the heavily rooted, shelly sands are surficial, subaerial and located on the channel margin.

**Interpretation:** Parasequence Md-Tr defines the modern transgression of the Barataria shoreline. In the sub-tidal area it consists primarily of a recently built flood-tidal delta in the inlet throat of Pass Ronquille.

**Transect CR-D Description and Interpretation**

**Transect CR-D / Parasequence BB-Tr**

**Description:** Cores D-1, D-3 and D-5 penetrate to below -6.0

m (Figure 96). Within this interval bedded shelly sands coarsen upward from 110 to 125 u between -7.0 and -6.3 m. Above -6.3 m the sands fine to 90 u, are rippled and contain moderate amounts of fragmented shells. In core, trough cross-bedding was observed. At a similar interval in core D-3 cross-bedded sands with a high shell content were also noted. Below -6.0 m in core D-5 lies stacked washover units. These are thin 5 cm intervals of sand that grade to finer-grained silty/clay units. Imbricated shelly material is seen in the thickest sandy unit of this sequence.

**Interpretation:** The bedded quartzose shelly sands in parasequence BB-Tr are interpreted to be of tidal inlet origin. The graded unit beneath core D-5 may be part of a marginal flood channel adjacent to the main channel. This entire parasequence is part of a barrier complex that grew laterally from an abandoned delta lobe headland.

**Transect CR-D / Parasequence Ms-Re**

**Description:** Interval -6.0 to -3.0 in transect CR-D appears to coarsen from west to east. The western three cores from D-3 through D-5 contain alternating units of laminated, burrowed, and lightly rooted clays. Cores D-1 and D-2 contain several thin sandy units with sharp erosive bases. Between -5.0 and -4.0 there are three separate overbank

## CROSS SECTION CR-D

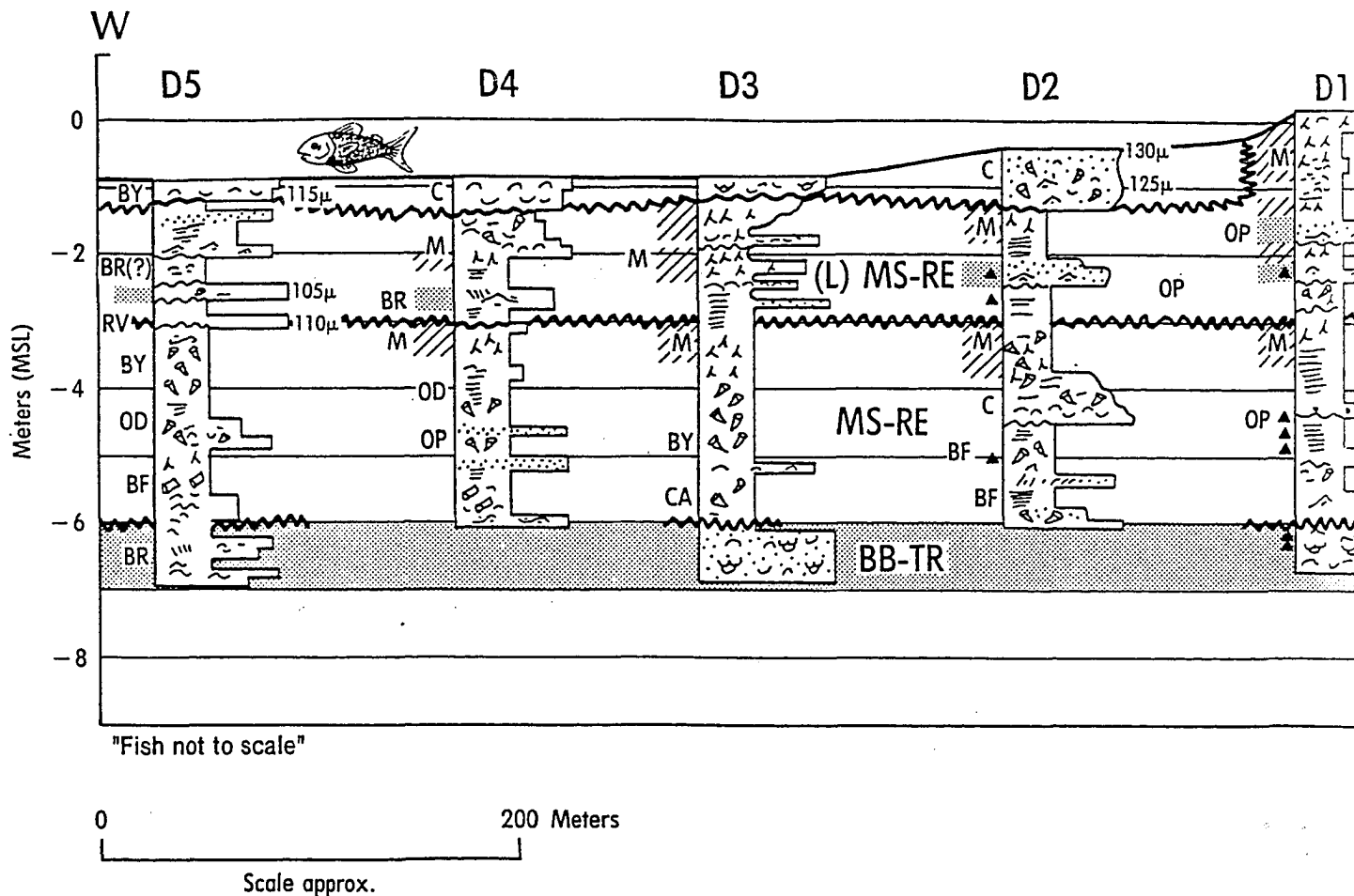
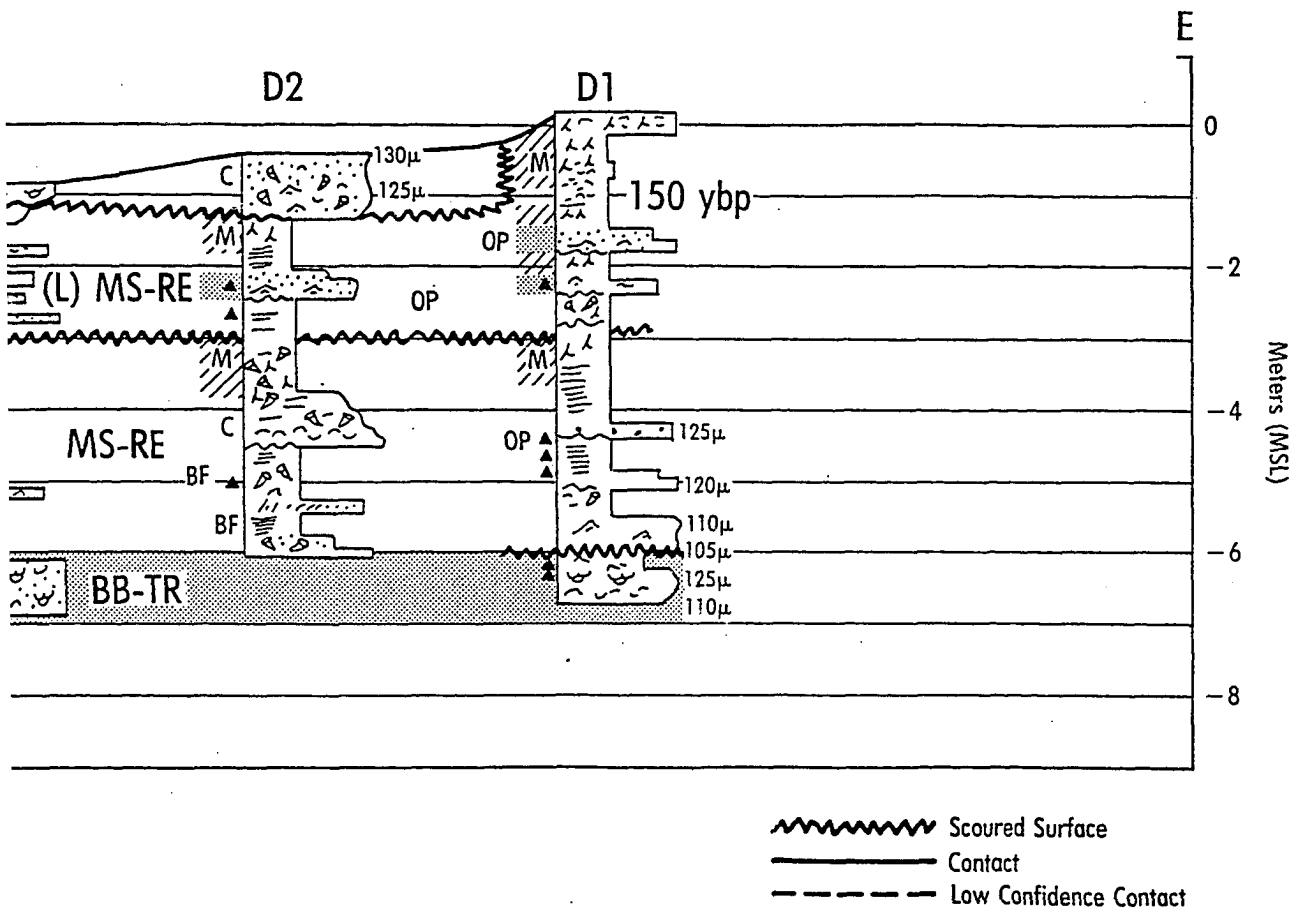


Figure 96. Transect CR-D. The coarse shelly sands in parasequence BB-Tr are probably flood tidal deltas and components of a barrier shoreline that once protected this part of the coast.





coarse shelly sands in  
flood tidal deltas and  
line that once protected this



units grade from sands to laminated clays. The basal sands at -4.0 m contain rip-up clasts. In all cores, except D-5, at -3.0 m this parasequence is capped by a fifty centimeter unit of light to moderately rooted marsh.

**Interpretation:** Parasequence Ms-Re is part of a delta lobe that built from the east. The direction of origin is drawn from the presence of active channel and proximal overbank deposits on the east side of this sequence.

#### **Transect CR-D / Parasequence Ms-Tr**

**Description:** At -3.0 m in transect CR-D marsh deposits are overlain by laminated bayfill muds on the east side. On the west side of CR-D the marsh surface appears truncated and buried beneath ripple bedded silts and a thin stratum of sandy shell hash.

**Interpretation:** The marsh surface on the west side of this transect exhibits characteristics of a bay floor. To the east, the contact between the delta plain marsh and bayfill muds is more subtle. The truncation between Ms-Tr and the overlying units is probably the result of a bay ravinement or marine flooding surface.

#### **Transect CR-D / Parasequence (Late) Ms-Re**

**Description:** Parasequence(Late) Ms-Re contains a variety of facies types. On the west side in core D-5 at -3.0 m, the underlying bay muds are overlain sharply by a five cm unit of shelly sands. The mean grain size of this sand is 110  $\mu$ .



A thinly laminated mud unit is interrupted by a second sandy unit with similar size sands. A similar sandy shelly unit has buried a marsh at interval -3.0 m in core D-4. In cores D-3 , D-2 and D-1 laminated clays cover marsh. The bayfill clays coarsen to ripple bedded sands which then grade to clays and marsh at -2.0 m. In core D-3 the marsh extends to -1.3 m. A sample of this marsh taken from core D-1 was radiocarbon dated 150 ybp.

**Interpretation:** Parasequence (Late) Ms-Tr contains a mix of progradational and retrogradational characteristics. These collective facies were probably located at the flanks of a prograding delta. The two-meter-thick parasequence of alternating sands and muds indicates that deposition in this area was probably episodic. The light to moderate shell concentrations in some of the sandy strata suggest that limited marine influences were also present.

#### **Transect CR-D / Parasequence Md-Tr**

**Description:** The marsh capping parasequence (Late) Ms-Re is buried beneath shell-rich sands. This average thickness of this coarse blanket is less than 0.5 m thick except in core D-2 where it is nearly a meter thick.

**Interpretation:** These sands are being transported into Pass Ronquille by waves and tidal currents. Historic maps and charts show that as recently as one hundred years ago the present pass area was dominated by marsh. Parasequence Md-Tr marks the most recent shoreline transgression to

affect this area.

### **Transect CR Description and Interpretation**

#### **Transect CR / Parasequence BB-Tr**

**Description:** Cores CR-5, CR-7 and CR-8 penetrated deeper than all other cores in this transect (Figure 97). In core CR-5, a 0.5 m thick sand unit heavily rooted with Spartina alterniflora was located between -5.0 and -4.5 m.

Radiocarbon dating of the in-situ vegetation revealed that it was buried 2440 ybp. Cores CR-7 and CR-8 (-6.0 to -4.5) consist of lightly burrowed, laminated bay fill clays. A sharp contact separates this unit from those above.

**Interpretation:** The facies observed in core CR-5 and the more landward CR-7 and CR-8 are products of different phases of the BB delta progradation. The beach ridge facies samples in core CR-5 are accretionary units deposited during the abandonment phase of the delta lobe life cycle. The bay fill units in CR-7 and CR-8 were deposited during the BB-Re progradation.

#### **Transect CR / Parasequence BB-Tr**

**Description:** BB-Re units are truncated by an erosional flooding surface. The rooted sand ridge in core CR-5 is buried by a sandy substrate containing a heavy concentration

## CROSS SECTION CR

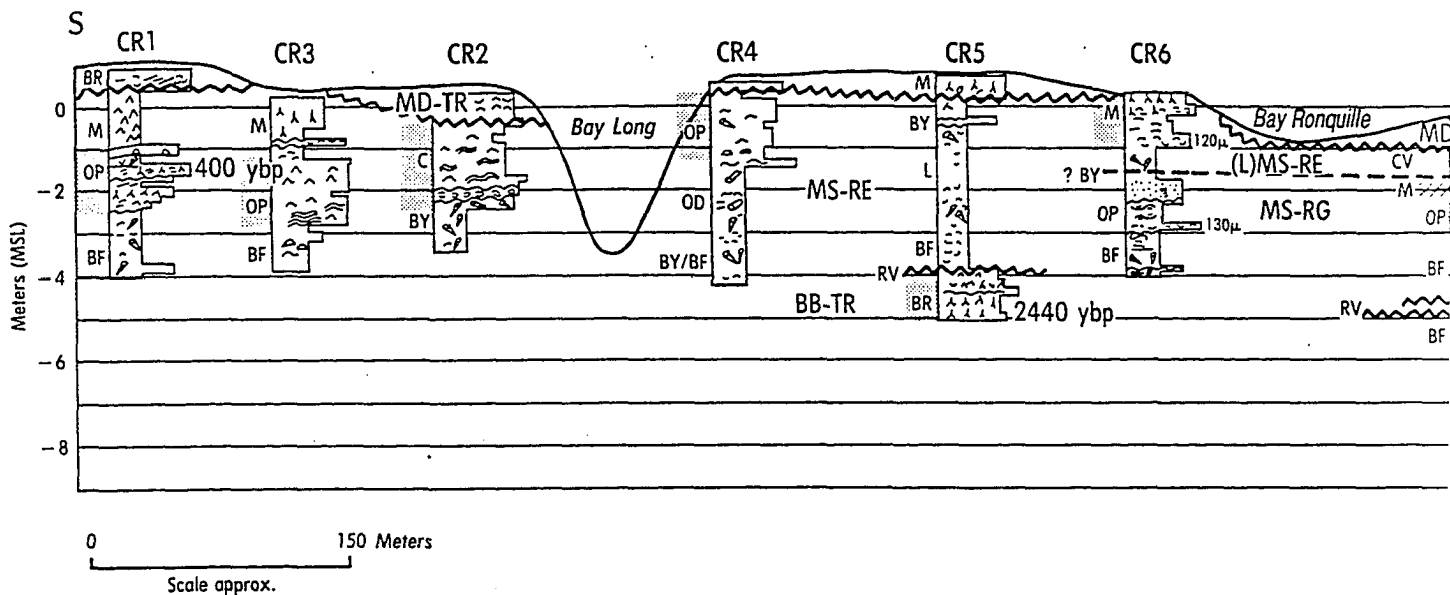
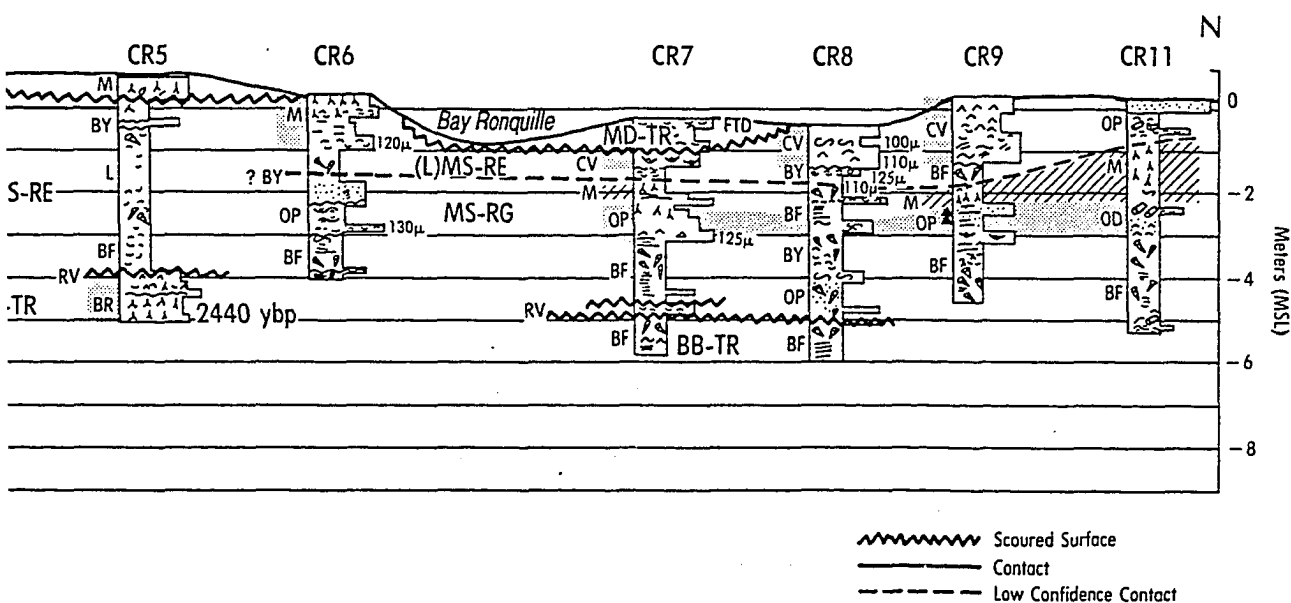


Figure 97. Transect CR. The vegetated sand ridge beneath core CR-5 defines a flank of the Bayou Blue barrier shoreline. Parasequence Ms-Re contains two meter thick active channel deposits. C-14 of roots within these deposits (CR-1) places its occurrence at 400 ybp. The landward cores of this transect, 8, 9, and 11, cross a lobe of a crevasse splay observed on 19th century maps.





e vegetated sand ridge beneath  
of the Bayou Blue barrier  
-Re contains two meter thick  
-14 of roots within these deposits  
ce at 400 ybp. The landward cores  
d 11, cross a lobe of a crevasse  
tury maps.



of articulated Rangia cuneata. This stratum is overlain by lightly rooted clays and muds. Sands with moderate shell content lie above a sharp contact at -5.0 m in cores CR-7 and CR-8. This stratum is approximately 20 cm thick in core CR-7. The sands fine rapidly to homogeneous clays. In core CR-8 two thin graded units are stacked above the lower contact.

**Interpretation:** The parasequence described in core CR-5 is typical of a washover sequence. The shell hash is deposited while the washover is active. During calmer periods the finer sediments settle out and become vegetated. That the rooted unit is overlain by subtidal facies suggests that this portion of the shoreline was eventually transgressed. The abrupt coarsening of lithologies above the bay fill in cores CR-7 and CR-8 is also interpreted to be the result of a transgression.

#### Transect CR / Parasequence Ms-Re

**Description:** Cores CR-1 through CR-4 contain complete and significant progradational sequences between -4.0 and the surface. The channel that presently connects Bay Long and Bay Ronquille separates cores CR-2 and CR-4. In cores CR-2 and CR-3 0.5 m bayfill and delta front units coarsen upwards to sands with a mean grain size of 125  $\mu$ . The active channel sands in core CR-2 contained abundant climbing ripples. Each of these cores contains approximately 2 meters of active channel sands. The mean

grain size of the sands in core CR-4 matched those sieved in core CR-3. Core CR-1 contains proximal overbank deposits correlated to the channel deposits in core CR-3. The immature, gray colored sands in these units were moderately vegetated. This organic material was C-14 dated 400 ybp. Core CR-5 is dominated by bay muds between -4.0 and -0.5 m. The active channel parasequence does not extend across to core CR-4. Note that cores CR-1 to CR-4 do not penetrate below -4.0 m. In cores CR-6 through CR-9 bayfill muds coarsen to ripple bedded sands between -5.0 to -1.5 m. The thickest sands were sampled in core CR-7 between -3 and -1.8 m. The mean grain size at the base of this fining upward unit is 125  $\phi$ . At -2.1 m the sands contain a thin layer of fine roots. These roots, in turn, are buried beneath a second fining upward unit between -2.1 and -1.7 m. Similar stacked fining upward sequences are noted in cores CR-6, CR-8 and CR-9. Rooting caps each individual unit. Core CR-11 contains subtle marker beds that may differentiate one vertical parasequence from the next. The upper contact of parasequence Ms-Re is at -1.5 m where lightly rooted clays are separated by a thin bed of distorted clays.

**Interpretation:** Parasequence Ms-Re contains significant thicknesses of active channel sands that flank the entrance channel to Bay Long. This suggests that the modern channel may be located in the original distributary



location. The concentration of channel deposits between cores CR-3 and CR-4 is strong evidence that this sub- delta lobe built through the Bay Long channel. The multiple stacked fining upward units in core CR-6, CR-8 and CR-9 represent crevasse splays. The sparse rooted stratum in core CR-11 represents inter-flood, perhaps seasonal, periods of emergence.

**Transect CR / Parasequence (Late) Ms-Re**

**Description:** At -1.6 m in cores C-6 through C-11, muds, alternately laminated and lightly burrowed, bury delta plain marsh. In all but core CR-11 the finer lithology coarsens to ripple-bedded sands. Some portions of the sands contain disarticulated and fragmented shells while others are shell-free. The sands fine upwards from 125u to 100u. The coarser units in cores CR-7 and CR-9 are distinctly ripple bedded. The sands contain infrequent organic laminations and are heavily rooted in cores CR-6 and CR-9. Above -1.6 m in core CR-11, a marsh unit is present to -0.2 m.

**Interpretation:** In cores CR-8, CR-9 and CR-11 parasequence (Late) Ms-Re is interpreted to be a crevasse splay. An 1841 shoreline map depicts crevasse splay lobes in this position (Figure 98). In cores CR-6 and CR-7 the distributary facies are thinner but still recognizable and correlated to those on the west side of the transect (Figure 97).

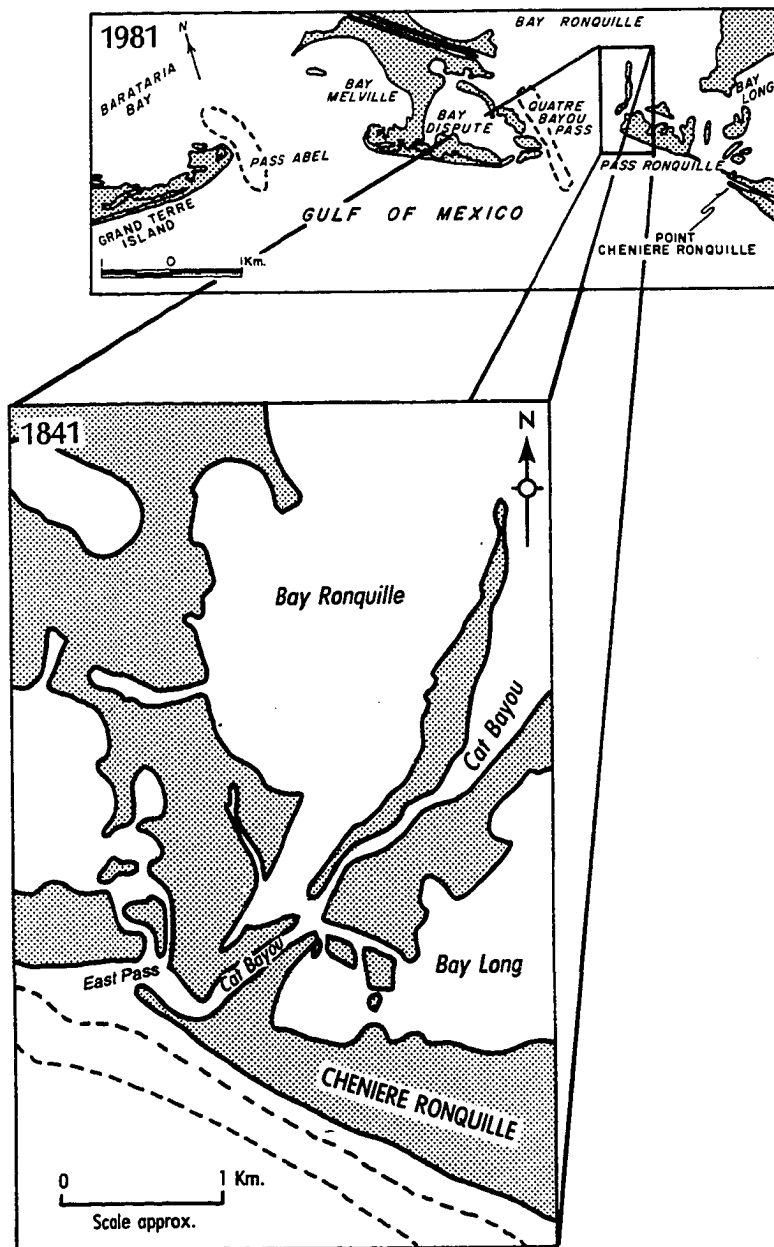


Figure 98. Quatre Bayou Pass, 1841. A crevasse splay formed through a breach of Cat Bayou covers the floor of Bay Long.

**Transect CR / Parasequence Md-Tr**

**Description:** The top fifty centimeters of cores CR-1, CR-2 and CR-4 contain shelly sands. In core CR-1 the coarser material lies between +0.5 and +0.9 m. In cores CR-2 and CR-4 the shelly sands flank the present opening between Pass Ronquille and Bay Long. The channel floor of Bay Ronquille was also sampled in core CR-7 (-1.0 to -0.3m). This interval has a sharp basal contact covered by ripple bedded sands that contain a moderate density of fragmented shells and rip-up clasts. Shell content increases toward the top of this interval.

**Interpretation:** Parasequence Md-Tr defines the present transgression of Chenier Ronquille. As the Bay Ronquille marsh subsides new channels are formed to distribute tidal waters. This is confirmed by historical maps of the Chenier Ronquille. Parasequence Md-Tr is a relatively recent deposition. Sands from the seaward barrier foreshore are being washed into the inlet throat and bay entrance channel areas. The sediments comprising this channel unit are typical of pass floor lithologies presently observed in the Barataria region.

TRANSGRESSIONS AND REGRESSIONS  
IN THE  
BARATARIA BIGHT REGION  
OF COASTAL LOUISIANA

Volume II

A Dissertation

Submitted to the Graduate Faculty of the  
Louisiana State University  
Agriculture and Mechanical College  
in partial fulfillment of the  
requirements for the degree of  
Doctor of Philosophy

in

The Department of Marine Sciences

by  
Douglas Ross Levin  
B.S., Fairleigh Dickinson University  
M.A., Boston University  
December 1990

## 8. LATE HOLOCENE HISTORY OF THE BARATARIA COASTAL REGION

Stratigraphic information gathered through this research, coupled with other subsurface investigations and scrutiny of historical maps allows the geologic history of this portion of the Louisiana Delta Plain to be refined. At least five different progradational sequences and four coastal transgressions have affected the Barataria region in the past 5000 years.

### Bayou des Families Regression

Frazier's (1967) program extended to 8 km offshore however his borings did not penetrate below -14 m (Figure 99). From his data he concluded that the Bayou des Families lobe was the first to build into the Barataria area. This delta progradation corresponds to Frazier's (1967) lobe number 7 (Figure 100). The offshore cores acquired by the Louisiana Geologic Survey (1982) extended to 8 kilometers offshore and sampled to depths in excess of -20 m (msl). The offshore dip-section (C-C') (Figure 77) and several cores from cross section A-A' (Figure 72) show progradational facies deeper than illustrated by Frazier (1967). Frazier's delta lobe chronology suggests that any of six of his seven early lobes may have extended into the Barataria area prior to the des Families (Figure 2).

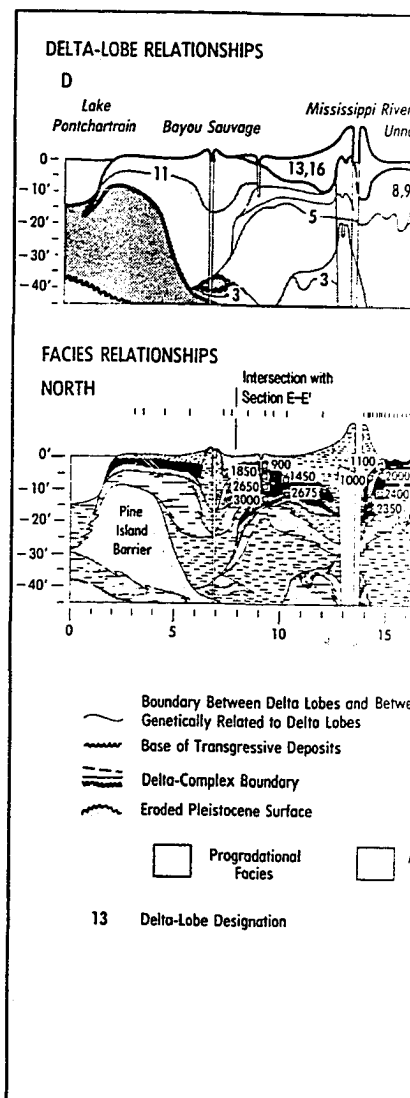
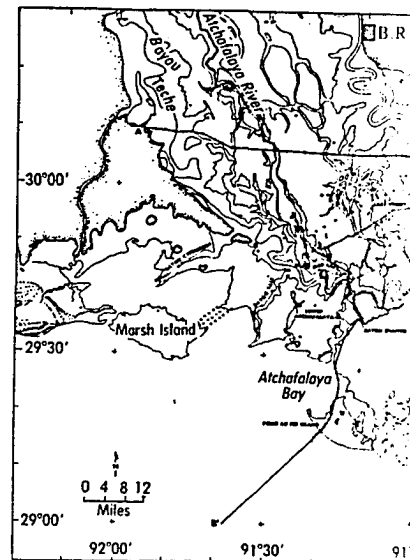
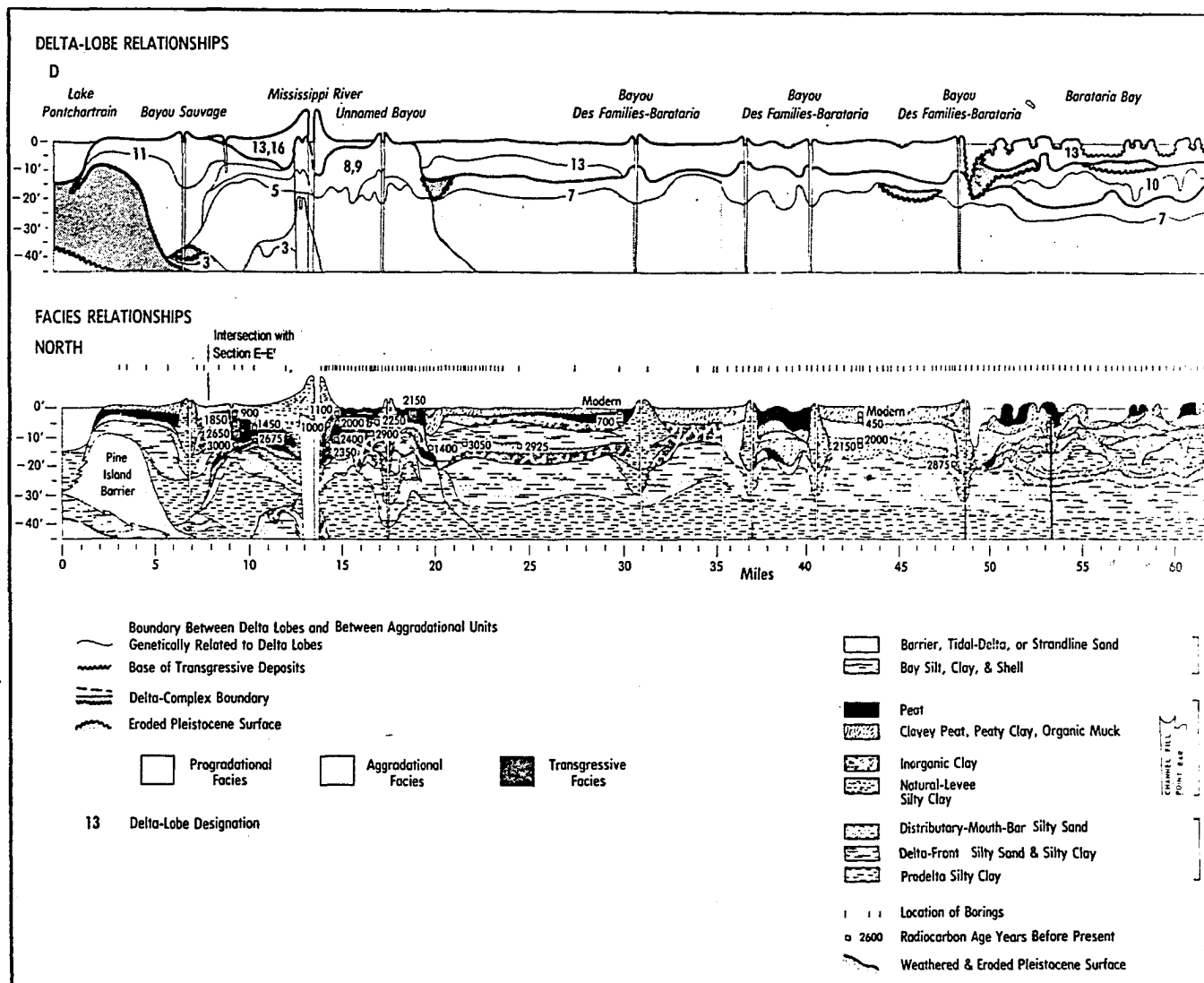
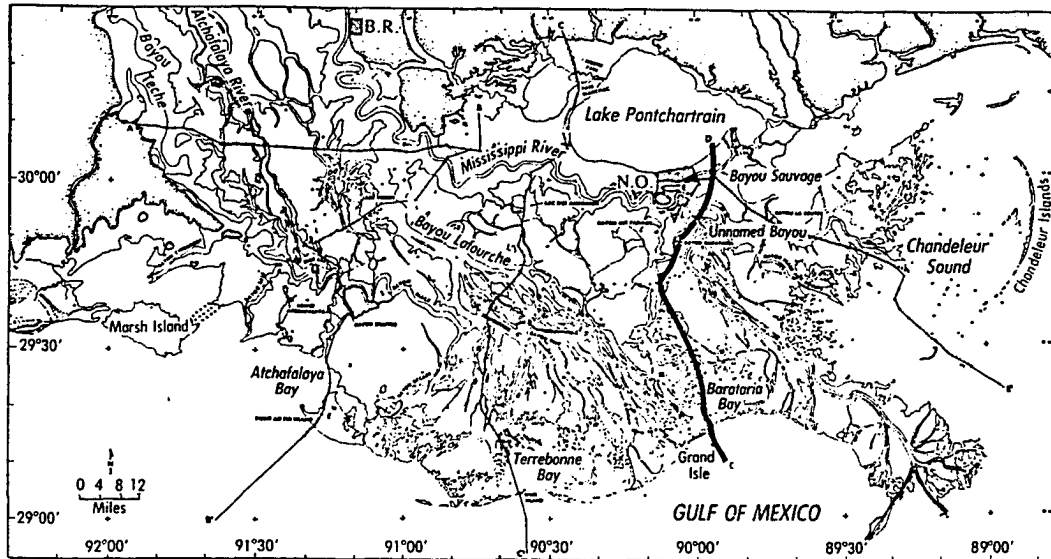


Figure 99. Frazier's cross-section D-D. Frazier's program only reported results to -14 m. According to Frazier's interpretation the Bayou des Familles lobe lies over the Bayou Terre aux Boeuf delta lobe.

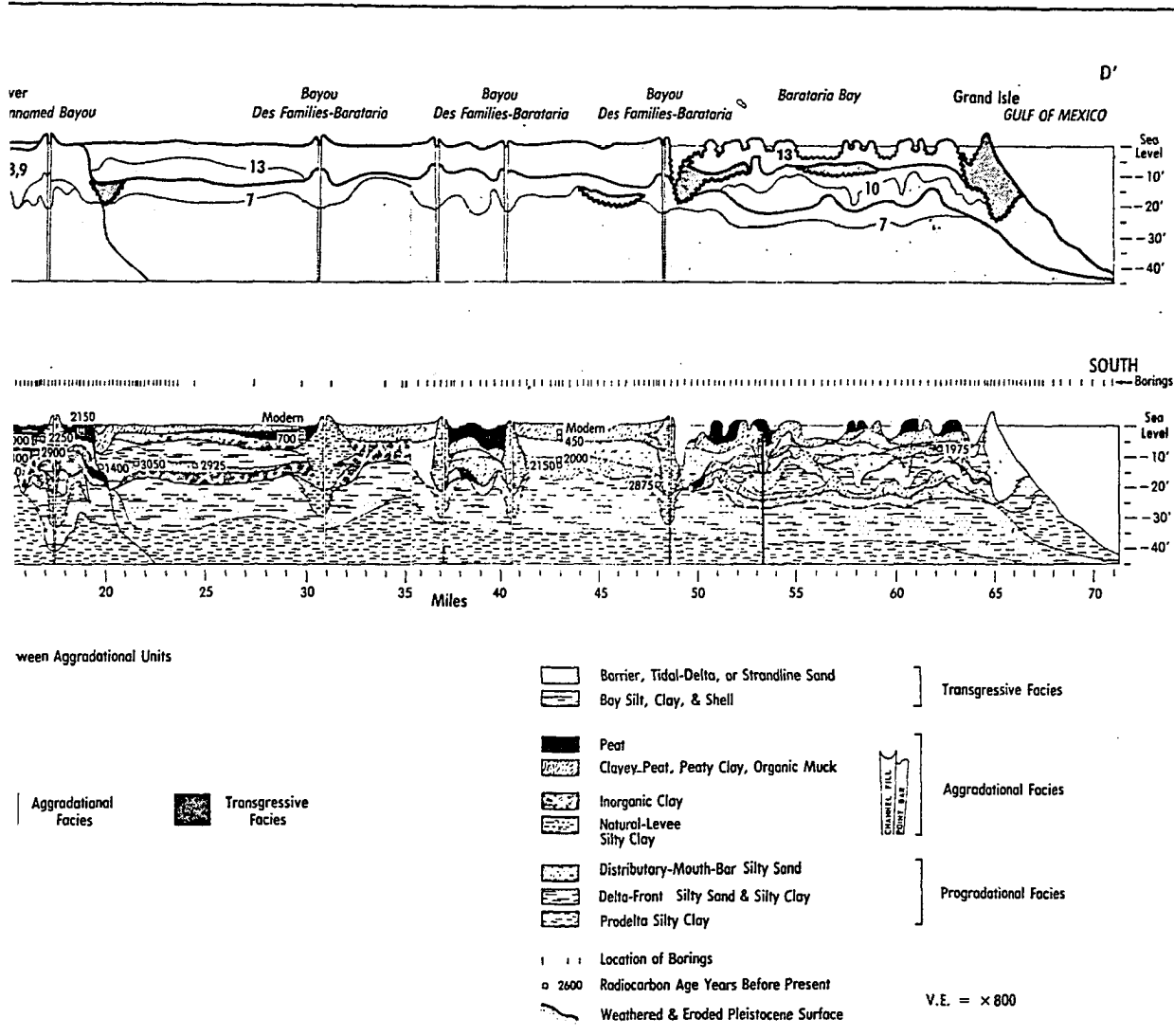
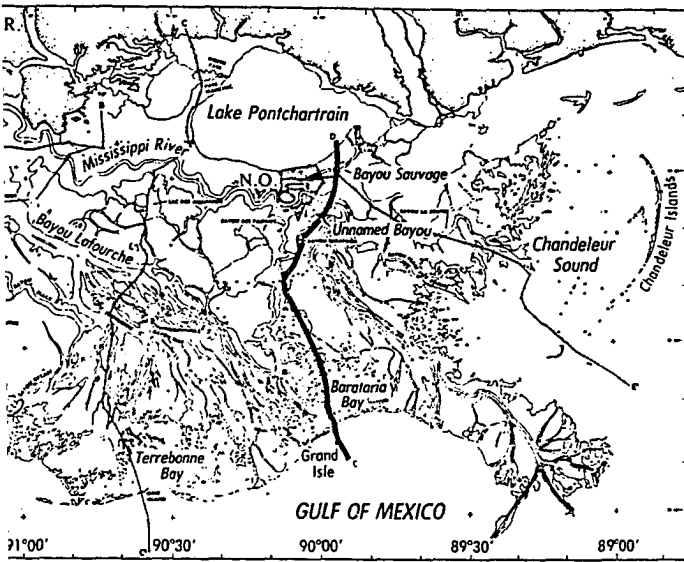




tion D-D.  
d results  
's  
amilies  
aux Boeuf









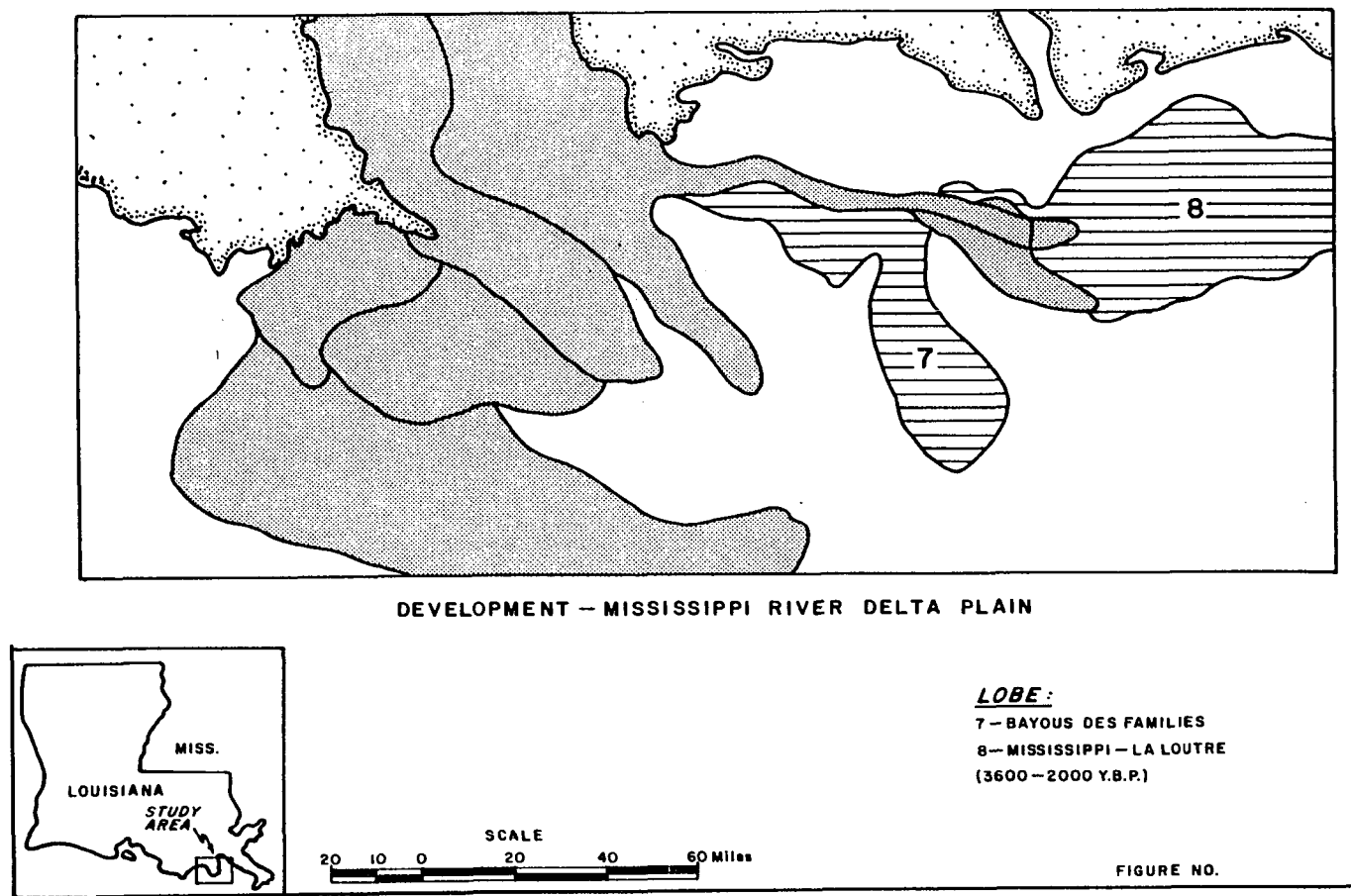


Figure 100. Frazier's lobe 7, depicting Bayou des Families progradation.

All of these lobes were active prior to 2100 ybp. The only one that can be ruled out is Bayou Cypremort as it lies considerably to the west. The two most likely candidates are lobe 5, Bayou Terre aux Boeufs (4100 - 3500 ybp) and lobe 6, the Bayou Terrebone lobe (3600 - 2100 ybp) (Figure 101). Frazier's cross-section D-D' indicates that Bayou des Families lies over the Bayou Terre aux Boeufs delta lobe (Figure 99).

Cores gathered for this dissertation penetrate deeper than Frazier's samples. There is no evidence of either transgressive sands or a ravinement surface between -20 m and 15 m. If the older delta lobes did reach to the Barataria offshore area they lie deeper than 20 m. The progradational facies observed in the deepest units are interpreted to be part of the Bayou des Families progradation.

Onshore cores may have penetrated the top of this delta lobe beneath -7 m. This depth of occurrence is at the limit of the onshore vibracore sampling system.

#### **Bayou des Families Transgression**

A clear transgressive surface cannot be found over the Bayou des Families progradation. Instead, a discontinuous lens of shelly sands and muds between -9 and -8 m has been mapped that separates the Families Re from the Bayou Blue Re (Figure 74). No surficial exposures of this transgression

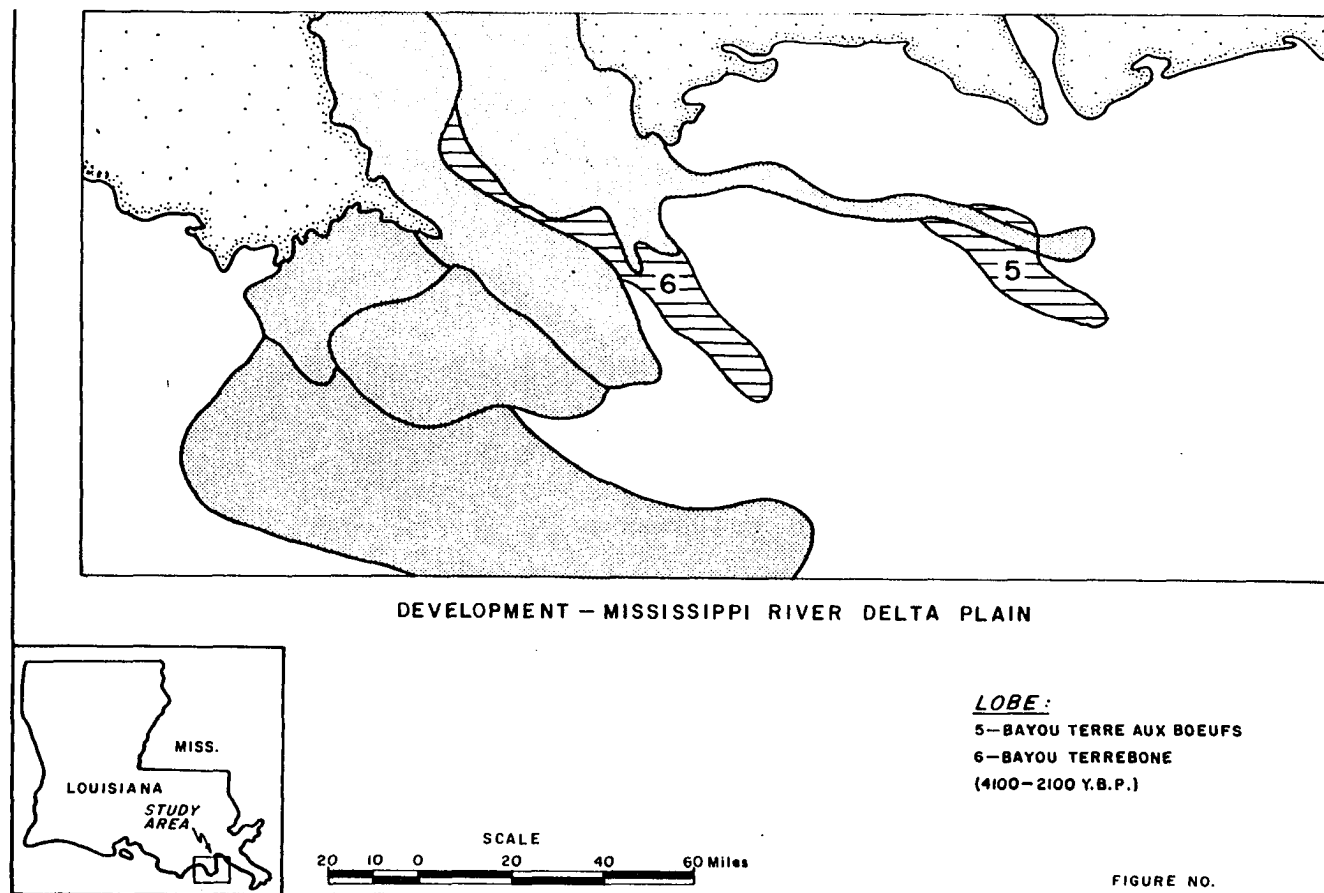


Figure 101. Frazier's (1967) early delta lobes 5 and 6, Bayou Terre aux Boeuf and Bayou Terrebone. Terre aux Boeuf is proposed to be the first holocene delta lobe to build into the Barataria area.

could be identified in the Barataria area. In dip-section PAE-C' (Figure 84) the Families Transgression is depicted as relatively flat. Delta plain marsh overlain by bay facies in core 16 suggests that this is a bay ravinement caused by marine flooding. The shoreface associated with this transgression lies further offshore than the seaward limit of this dataset. The landward limit of the Bayou des Families bay ravinement was extracted from Frazier's (1967) work. The bay/mainland contact was determined to lie at the upturn of the Bayou des Families/ Bayou Blue contact, depicted in his cross-section D-D' between miles 62 and 72 . By projecting the bay edge profile to sea level, the landward limit of the bay transgression was estimated to lie nearly nine kilometers landward of the present shoreline (Figure 102).

#### Bayou Blue Regression

In cross-section, Bayou Blue (lobe 10) has been identified as the next delta lobe to build into the Barataria area (Figure 103). According to Frazier's (1967) chronology the Bayou Blue progradation was initiated around 1970 ybp and abandoned within a span of one hundred years. The basis of this conclusion appears to rest on three carbon-14 dates taken landward of Grand Isle at a depth of 3 m. The large expanse of the Bayou Blue delta lobe projected by Frazier appears incongruous with such a limited time span. A

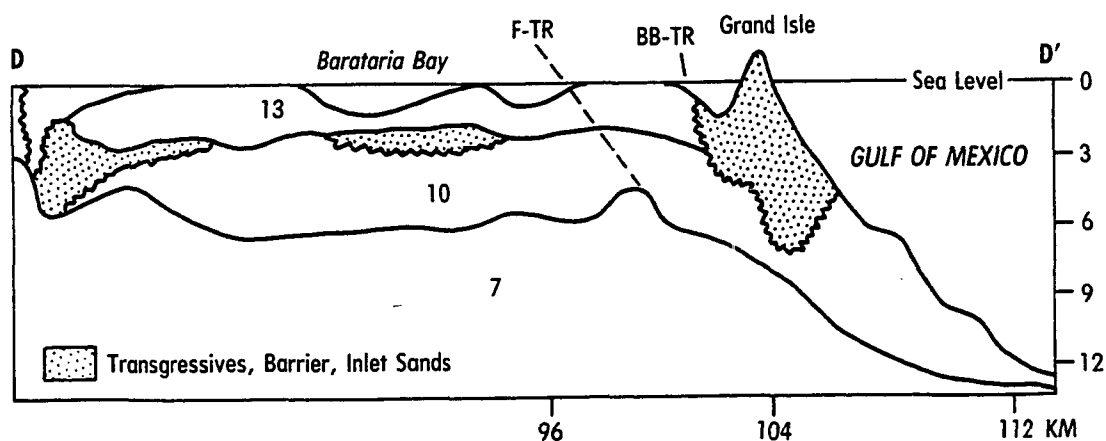
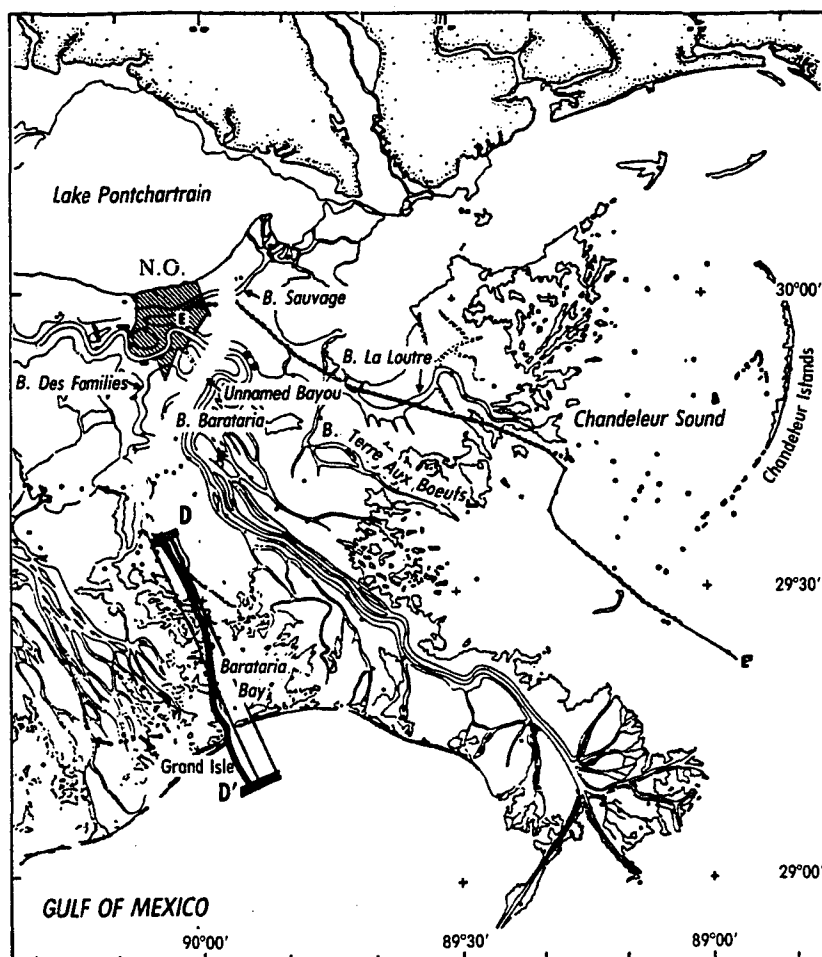


Figure 102. Frazier's (1967) cross-section D-D' simplified. The landward limit of the Families transgression is implied from the curvature of the contact between lobes 7 (des Families and lobe 10 (Bayou Blue).



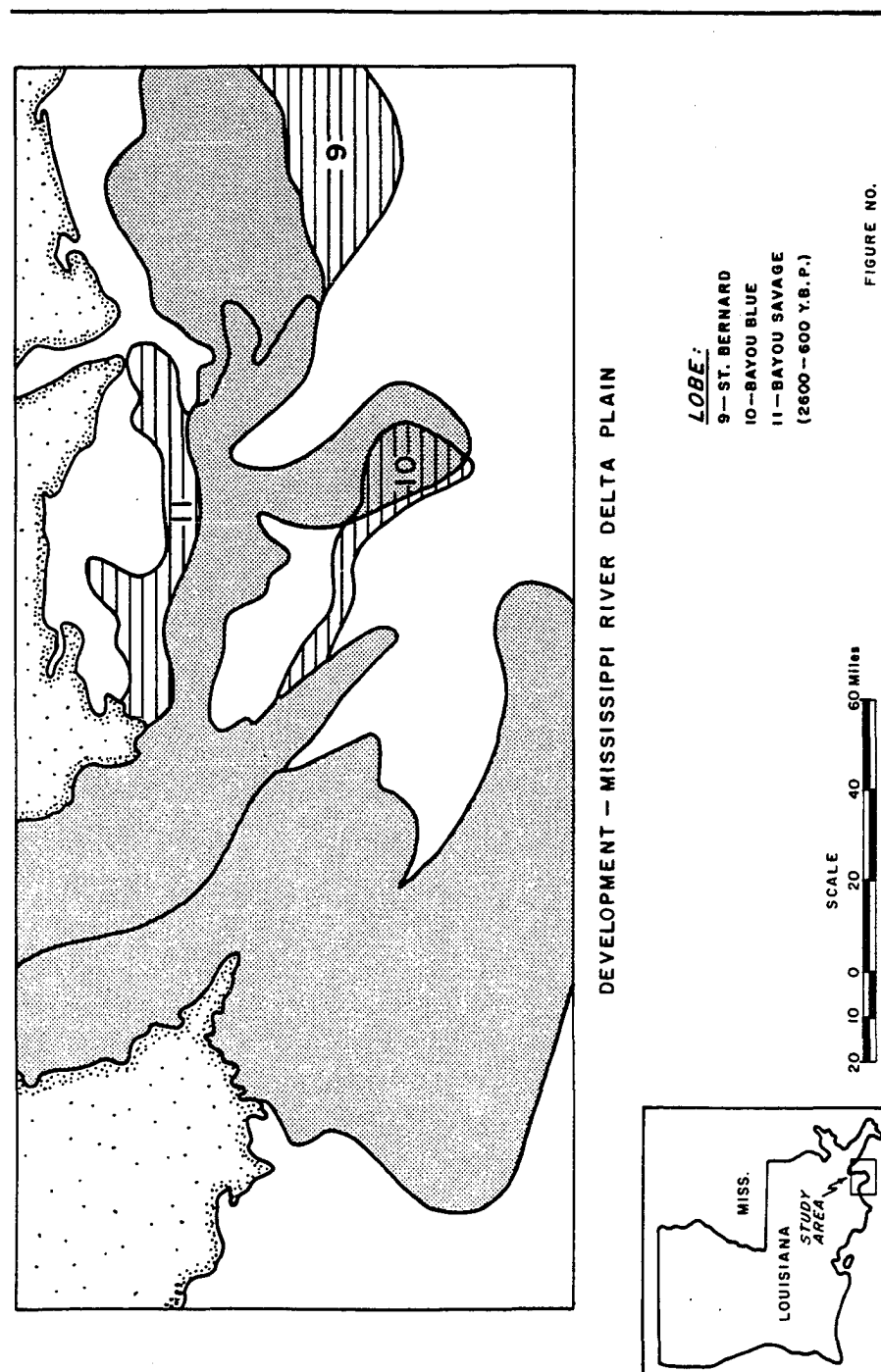


Figure 103. Frazier's lobe 10, Bayou Blue progradation.

stratigraphic model derived from this thesis concludes that Bayou Blue was active for a considerably longer period of time.

The offshore cores sampled a regressive packet between -9 and -4 m. The base of this delta lobe lies at the 9 m isobath which is also the approximate depth limit of shoreface retreat. Onshore cores in the Pass Abel and Quatre Bayou Pass regions recorded a progradational stratigraphy above -8 m (Figure 104). In Pass Abel, the top of the Bayou Blue progradation was at an elevation of -3.0 m. To the east, in Quatre Bayou the top elevation of Bayou Blue drops to -4.0 m. This occurs because the depocenter of Bayou Blue was located on the west side and dipped in the direction of Quatre Bayou Pass. Moslow and Levin (1985) concluded that channels above -8 m in the offshore region were formed during the Bayou Blue progradation.

The distributaries responsible for this progradation were centralized in the Pass Abel and Quatre Bayou Pass area. A marsh sample taken from -4.5 m in core PAE 2/3 and dated 1970 ybp capped one of the distributaries of the Bayou Blue progradation (Figure 83). Identical dates were taken from peats at -3 m behind Grand Isle (Frazier, 1967).

On the east side of Quatre Bayou Pass in transect C and D (Figures 31 and 32, respectively) and throughout the Chenier Ronquille area the BB-Tr facies are predominantly

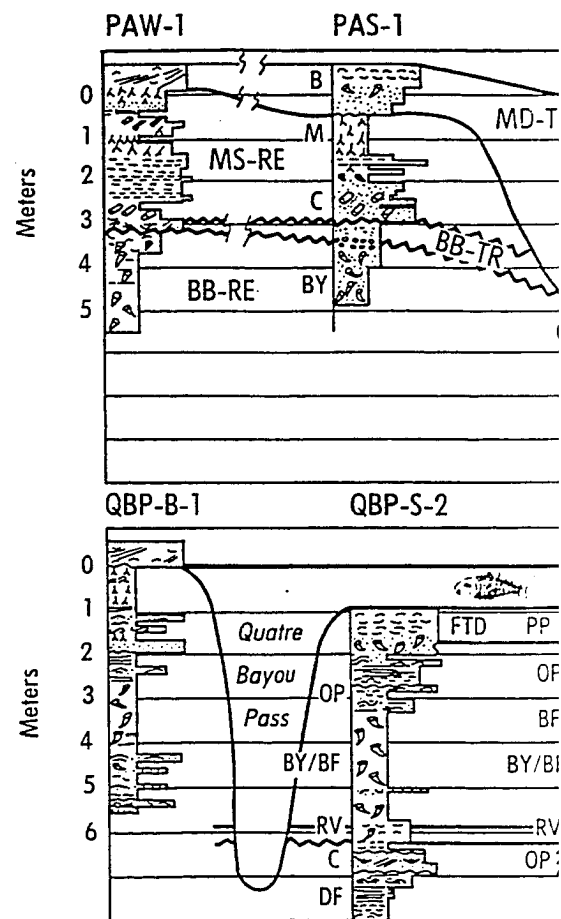
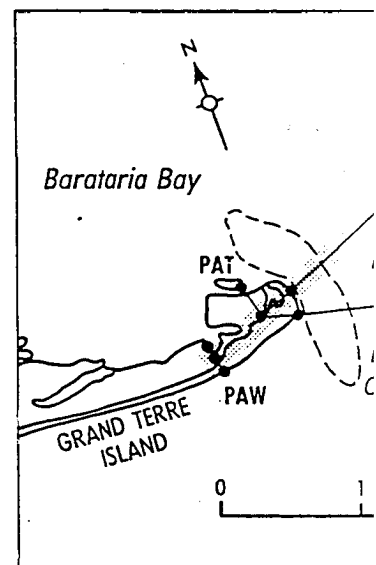
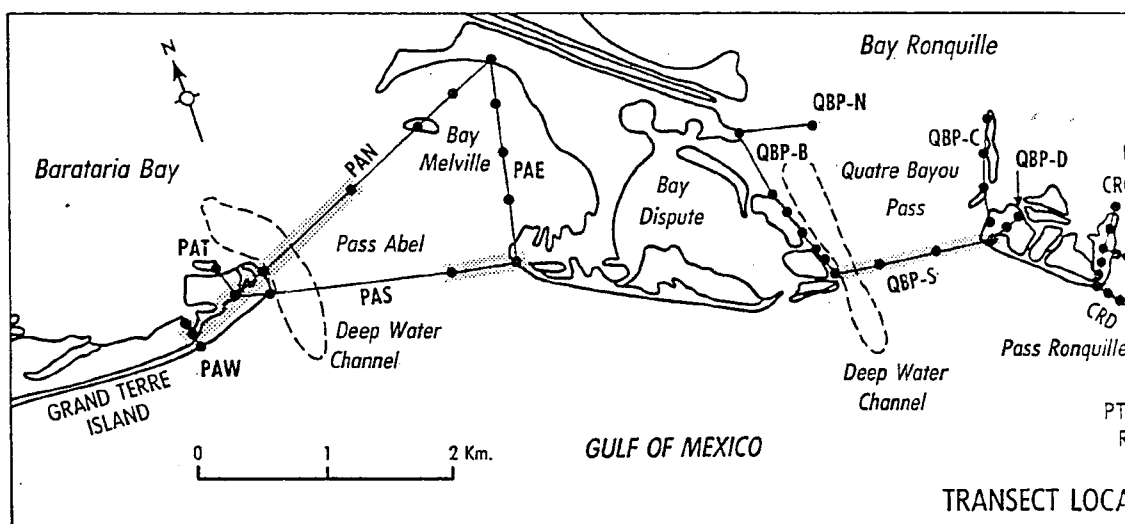
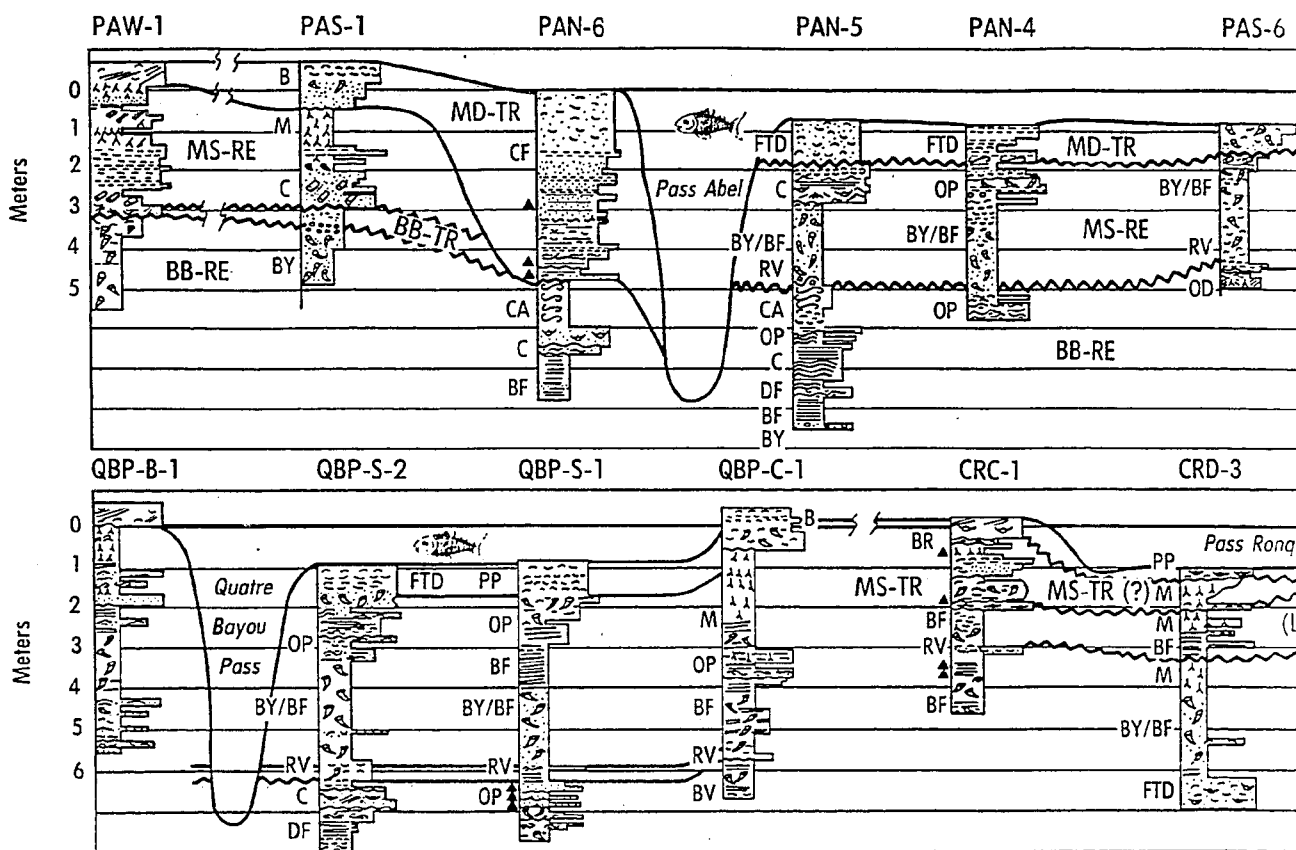


Figure 104.. Geologic cross-section from the Caminada Headland to Point Chenier Ronquille. The inlet sands beneath cores CRD-1 and CRD-3 are located landward of the old Bayou Blue barrier shoreline.



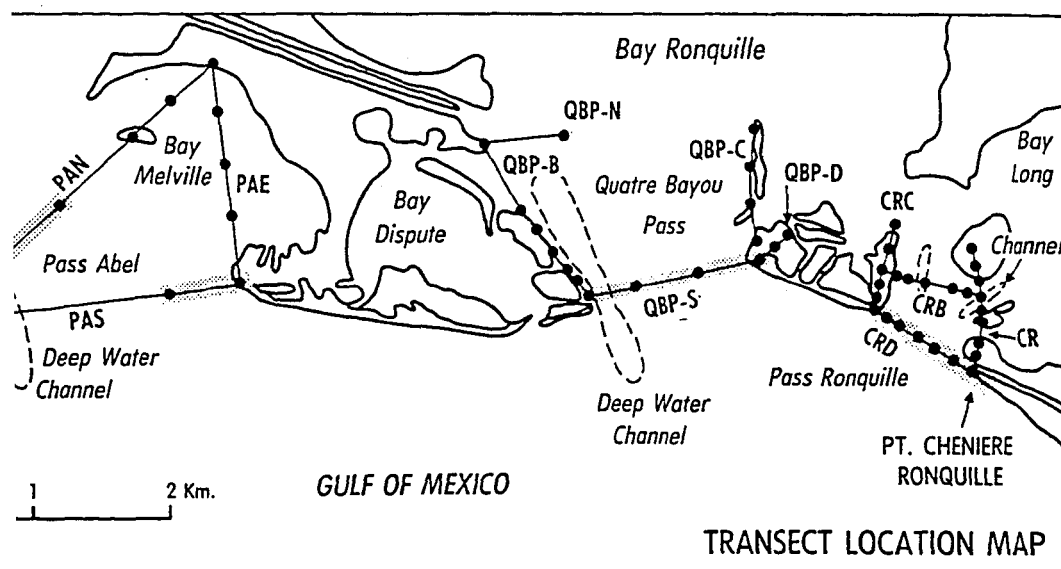
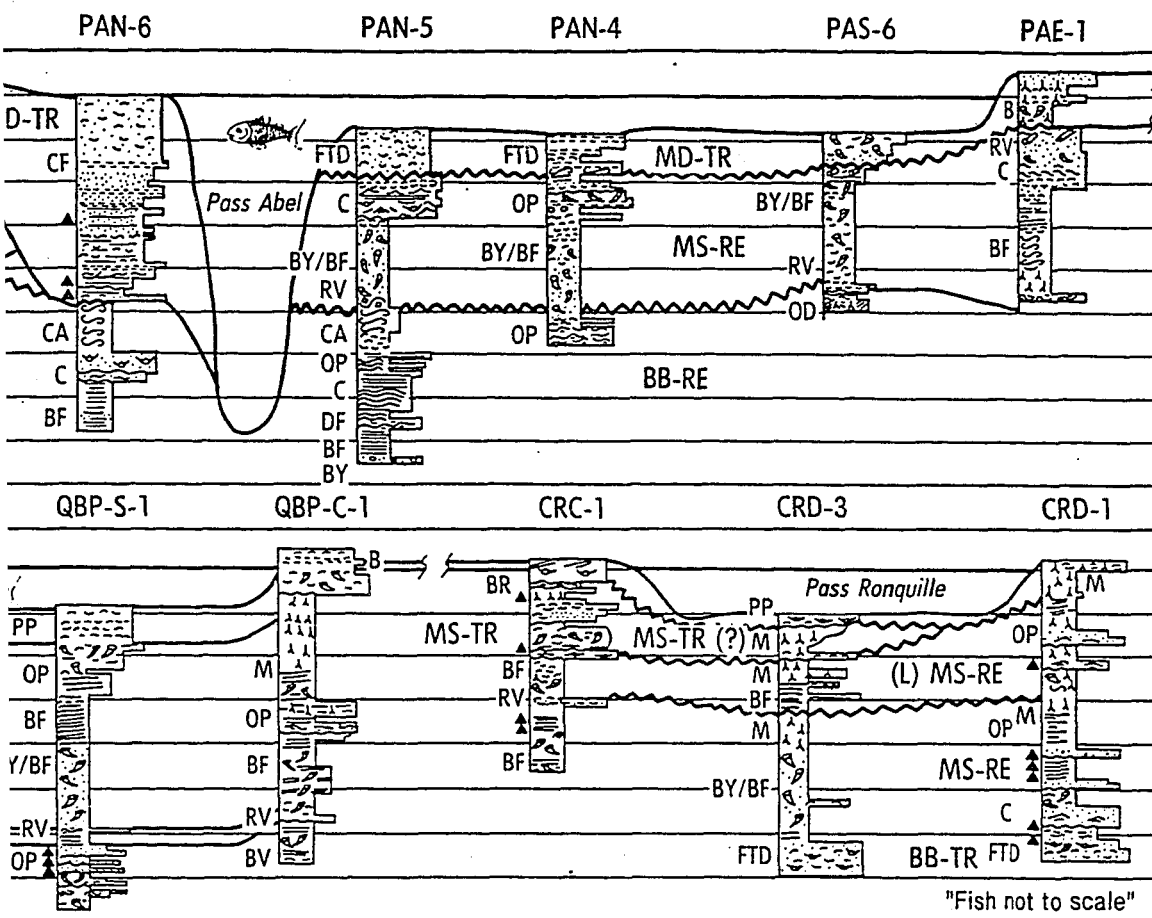




cross-section  
land to Point  
inlet sands  
and CRD-3 are  
the old Bayou

TRANSECT LOCALITIES









coarse grained quartzose sands. Shell content within these units is also relatively high. In Chenier Ronquille a strand plain lying below -5.5 m (Figure 97) is correlated with the Bayou Blue progradation. A sample of Spartina alterniflora taken from a beach ridge sampled by core CR-5 at -5.0 m was dated -2440 ybp.

The preservation of beach ridges within Chenier Ronquille has been recognized in previous research (Welder, 1959). In fact, using cores provided by the USCOE, he defined the seaward extent of two beach ridge sets (Figure 2). The tops of these beach ridges lie at a depth of about four meters. Welder (1959) contended that the eastward flanks of these ridges are no longer visible owing to burial and accelerated subsidence resulting from modern Mississippi River delta sedimentation. The ridge dated beneath core CR-5 is correlated to Welder's landward packet of beach ridges.

In a beach ridge plain the age of successive ridges decreases seaward. According to Welder's work this ridge is several kilometers seaward of the landward limit. This would suggest that the entire strand plain is even older than the C-14 date indicates. The beach ridge dated 2440 ybp occurs at a similar elevation to the marsh capping the distributary channel dated 1970 ybp located four kilometers to the west. The beach ridges probably formed during the abandonment phase of the Bayou Blue delta lobe progradation. However,

based upon the significantly younger occurrence of the adjacent delta plain marsh, it appears that distributaries of Bayou Blue were still partially active while the strand plain was being built. Based on these C-14 dates the minimum longevity for the Bayou Blue progradation is 500 years, between 2600 and 1900 ybp.

### **Bayou Blue Transgression**

The Bayou Blue delta lobe was affected by a period of regional transgression following its abandonment. Data from several sources, in addition to that derived from this dissertation, have been used to identify an area that appears to have been the location of a past transgressed barrier shoreline. The combined dip section PAE-C' (Figure 84) shows that the contact between the Bayou Blue progradation and the ensuing transgression is relatively flat. An eroding shoreface would have a steeper profile than the flatter open marine ravinement surface (Figure 78). Hence, based on the onshore /offshore orientation of the true shoreface profile would have been located seaward of this position. However, the stratigraphic evidence collected during this program combined with other regional studies supports the conclusion that an earlier barrier shoreline once occupied this position.

The contact between the two strand plains identified by Welder (1959) is interpreted as the limit of the Bayou Blue transgression for the Chenier Ronquille area (Figure

2). Figure 102 depicts Grande Isle lying against a contact that cuts into Bayou Blue deposits. The contact is probably the Bayou Blue ravinement surface. A cross-section across the Bayou Moreau Headland also reveals the landward extent of the Bayou Blue transgression. In-situ reef material gathered slightly landward of the northern most Caminada-Moreau beach ridge plain was C-14 dated  $2430 \pm 100$  ybp (Otvos, 1969) (Figure 105). In-situ shells material dated 710 ybp was taken from beneath the landward most ridge (Gerdes, 1982). The diastem between these two samples probably represents the Bayou Blue Transgression. Using all of this data a line was drawn across the Caminada/Moreau headland to the landward edge of Grand Isle and eastward to the landward contact of the beach ridge plain identified by Welder, 1959. This line delineates the landward extent of the Bayou Blue transgression (Figure 106).

Geologic cross-sections of the Barataria Barriers also capture the landward limit of the Bayou Blue transgression. In core PAS-1 at -3.4 m (Figure 87) shells from a transgressive lag were radiometrically dated  $3700 \pm 80$  ybp. In Quatre Bayou Pass, 4.5 kilometers to the east, at a depth of -5.0 m, another transgressive shell lag was C-14 dated  $3560 \pm 100$  ybp (Figure 89). This shell lag lies stratigraphically higher than the Bayou Blue channel interpreted to have been active between 2500 and 2000 ybp

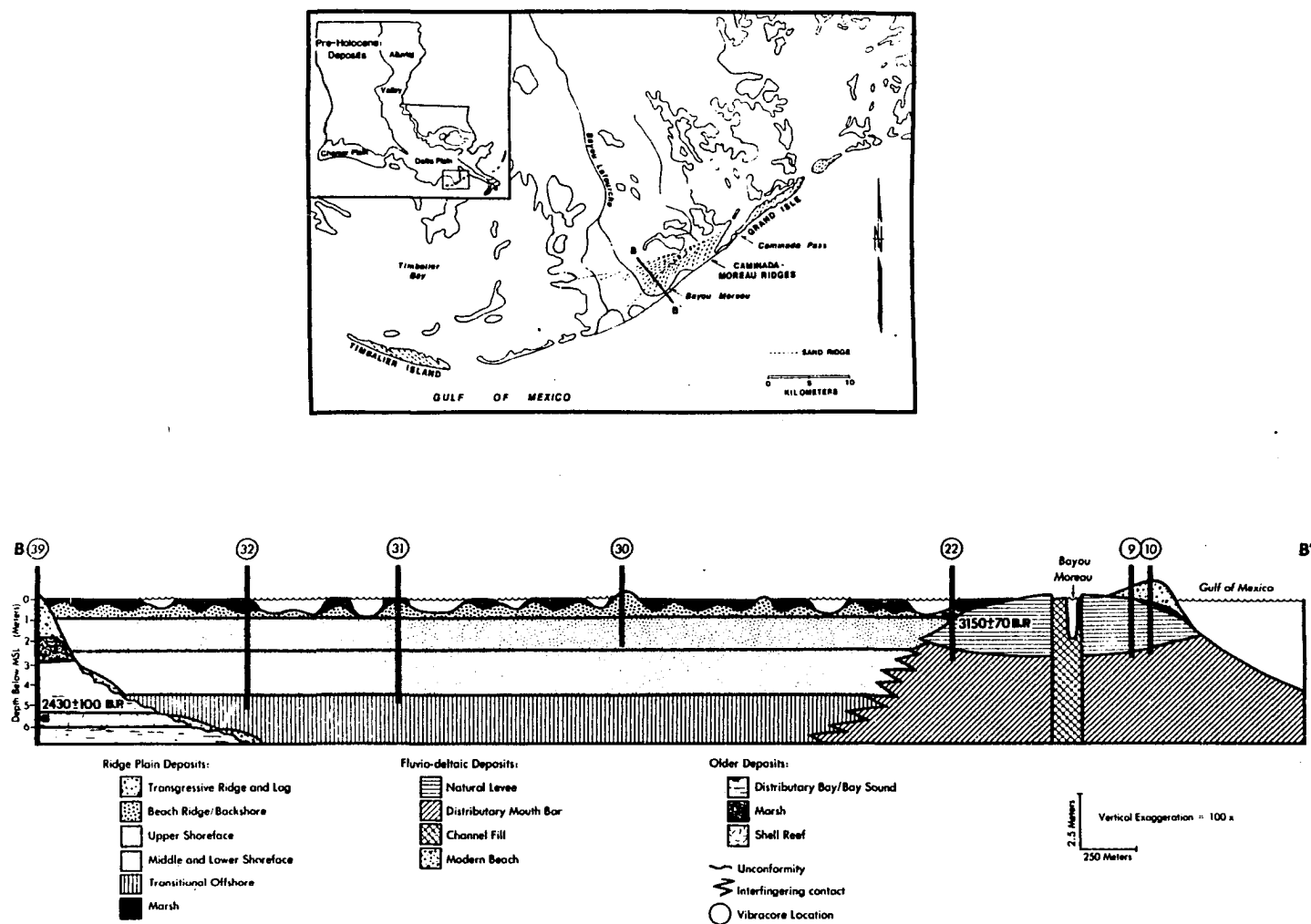


Figure 105. Gerdes (1983) cross-section across the Caminada/Moreau Headland. The limit of the Bayou Blue transgression lies between Gerdes core designation 39 and 32.

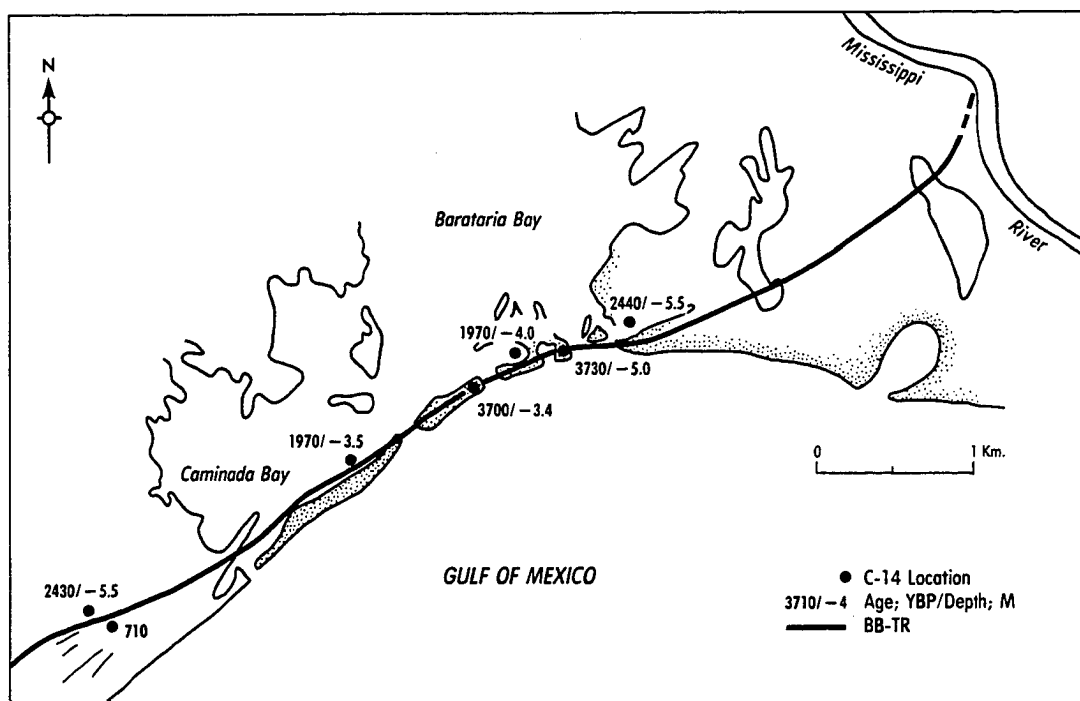


Figure 106. C-14 dates plotted across the proposed limit of BB-Tr. The 1970 ybp dates are near the Barataria headland, the area of Bayou Blue distributary origination. Transgressive shell lags dated 3700 ybp lie stratigraphically higher than the earlier dates.

and represents transported material lying on top of the Bayou Blue ravinement surface. This contact takes a significant turn towards the surface between cores PAN-2 and PAE-6 in transect PAN (Figure 81). Transect PAE (Figure 83) also exhibits an upward turn in this contact between cores PAE-2/3 and PAE-6, albeit more gradual than seen in transect PAN. This upturn is interpreted to represent the landward limit of Bayou Blue shoreface retreat. A similar inflection in the contact between BB-Re and Ms-Re is seen further to the east in transect QBP-B. Between core B-4 and B-5 the interpreted contact between BB-Re and Ms-Re rises nearly one meter (Figure 89). More importantly the contact between BB-Re and Ms-Re is conformable in core B-5. It does not show evidence of any truncation from the lower units, as it does in core B-4. The actual limit of the Bayou Blue transgression is located between core B-4 and B-5.

Further evidence of the Bayou Blue barrier is seen in the onshore regional cross-section (Figure 104). Flood-tidal facies beneath cores CRD-3 and CRD-1 are relics of a barrier system that was probably located slightly seaward of the present shoreline location.

### **Mississippi Lobe Progradation**

The Bayou Blue transgression was followed by the progradation of the Mississippi River delta lobe. According to Frazier's (1967) chronology of the Mississippi River

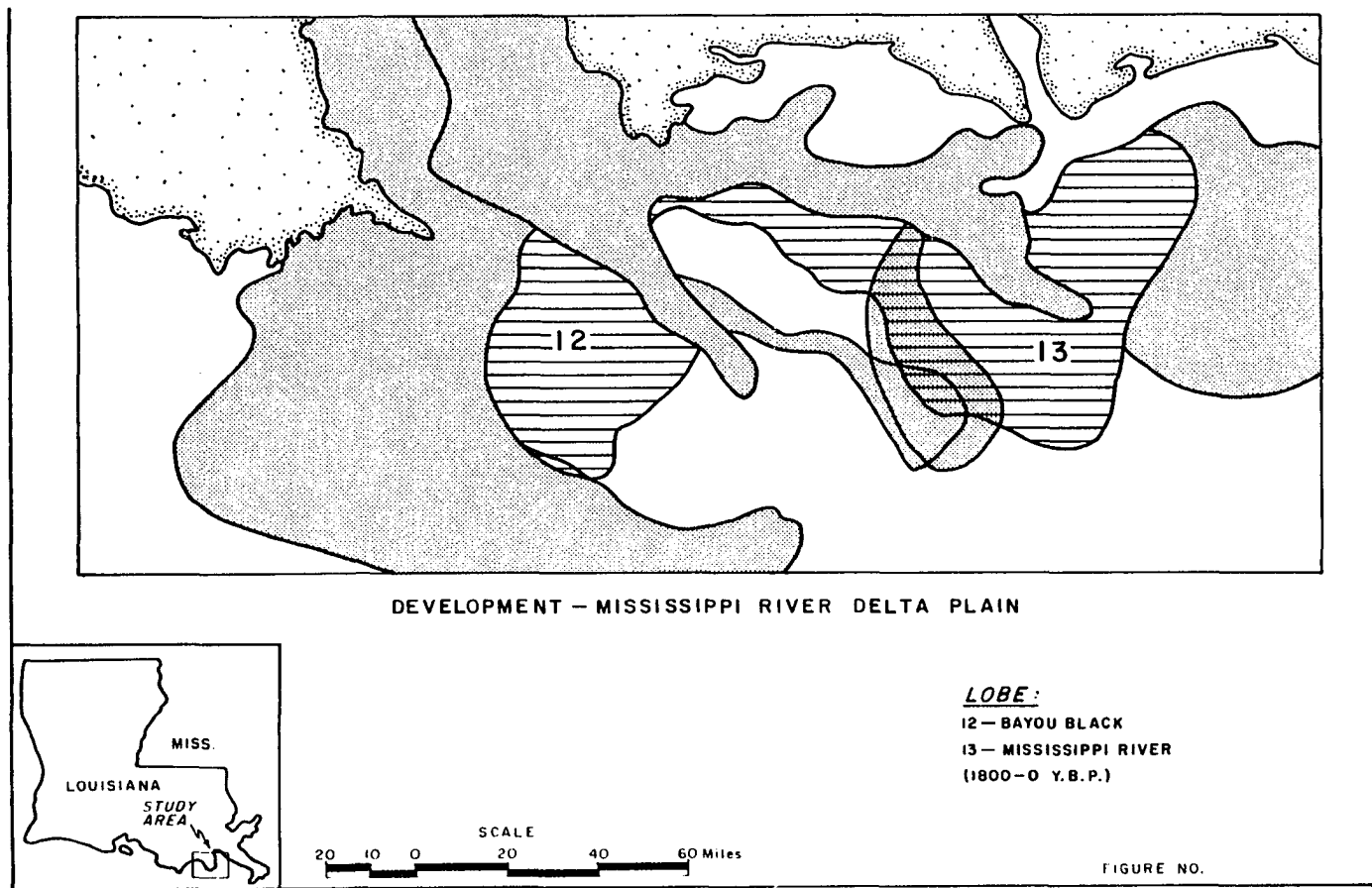


Figure 107. Frazier's Lobe 13, the Mississippi Lobe progradation.

delta plain this is delta lobe number 13 (Figure 107). He concluded that this delta was active from 800 ybp to the present and covered the eastern Barataria region.

Cross-sections of cores taken onshore in the eastern Barataria area sampled an extensive progradational parasequence that ranged from -5.5 m all the way to the present marsh surface. Two samples of in-situ vegetation extracted from this delta lobe were radiometrically dated. Both samples were located at approximately -2 m. Heavily rooted overbank material taken from the west side of Pass Ronquille was buried 850 +/- 60 ybp. A small sample of woody roots buried beneath overbank sands in Quatre Bayou was dated 710 +/- 350 ybp. The C-14 date at the entrance to Bay Long (Figure 97) is 300 years younger than western delta components at equal elevations (Figure 108). It is suggested from stratigraphic and map evidence that the Mississippi Delta Lobe built several sub-lobes from west to east during its period of activity.

Historic maps show clearly that relict distributary channels were present in the eastern Barataria region as recently as 100 ybp. An 1887 regional map of the Mississippi River delta plain outlines channels originating from the main trunk of the Mississippi River (Figure 109). One of the main distributaries can be traced south-southwest through Bayou Johnson and Quatre Bayou Pass. Based upon the Carbon-14 dates and the orientation of



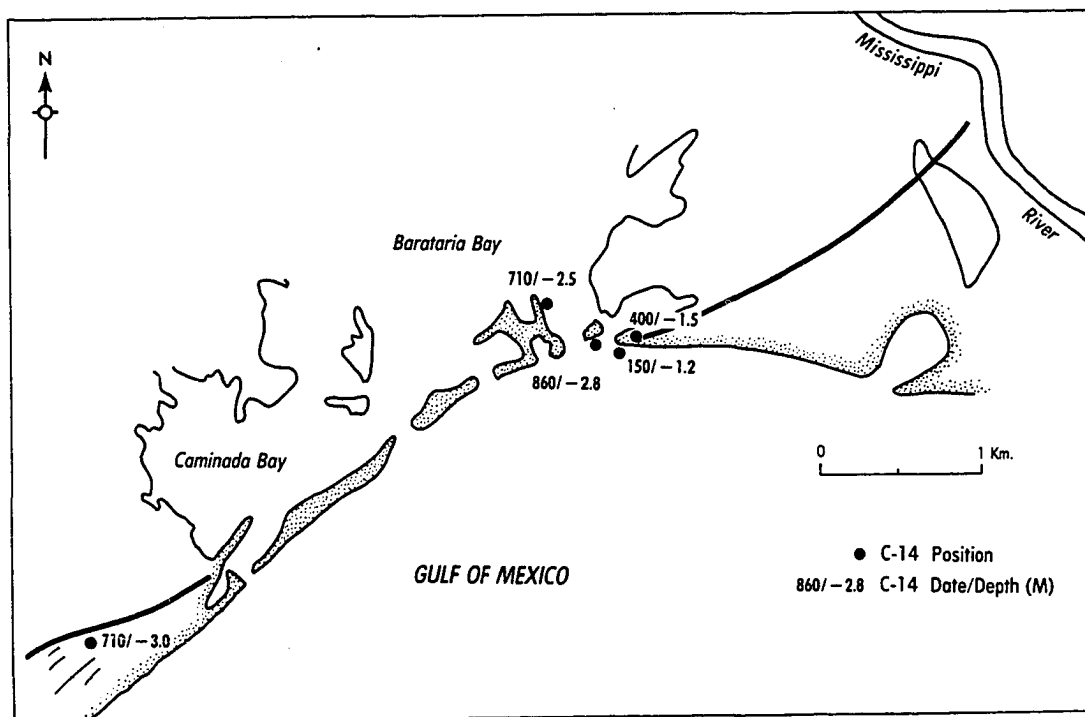


Figure 108. C-14 dates later than 1000 ybp plotted across the Barataria shoreline map. The 710 and 860 ybp dates mark the Mississippi Lobe progradation. The later dates nearer Chenier Ronquille are proposed to represent an eastern sub-lobe of the Mississippi lobe.

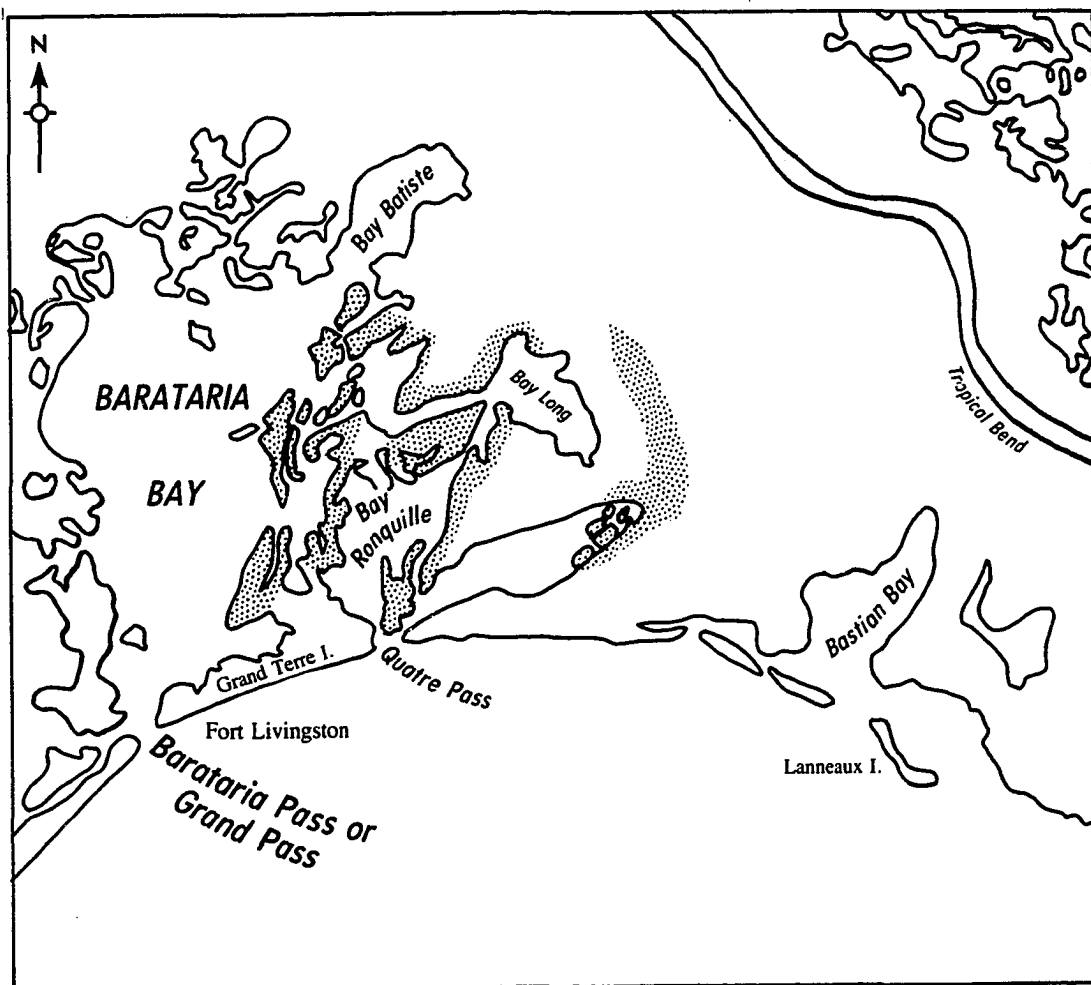


Figure 109. Map of southeastern Louisiana by Leach and Turtle, 1887. The shaded regions depict distributaries of the eastern sub-lobe of the Mississippi Lobe progradation. The eastern most channel runs along the mid-axis of Bay Long.

distributary channels depicted in maps, it is concluded that the Mississippi Lobe grew in stages from west to east. The older sub-lobes dated 800 ybp built through Bayou Johnson and Quatre Bayou Pass. Following its abandonment waves redistributed the headland sediments to the west and the east. Beach ridges in Grand Terre Barrier Island show that it was formed from east to west (Figure 110). It is interpreted to be a spit that formed during the abandonment phase of the westward component of the Mississippi River delta lobe. Offshore evidence of this delta progradation is absent. It has been erased by the most recent phase of shoreface retreat.

Later, around 500 ybp, a more eastern distributary captured the Mississippi lobe flow and constructed a lobe through what is now known as Bay Long delta lobe (Figure 111). Because this distributary branched from of the Quatre Bayou and Bayou Johnson, it will be referred to as the Late Mississippi lobe. The seaward beach ridge plain mapped by Welder (1959) is proposed to have originated from the Late Mississippi lobe and built against the modern Mississippi River channel as it prograded southward (Figure 111). This phenomena has also been used to explain distal fanning of the Caminada-Moreau beach ridges. Gerdes (1982) concluded that they built out against the levees of Bayou Moreau.

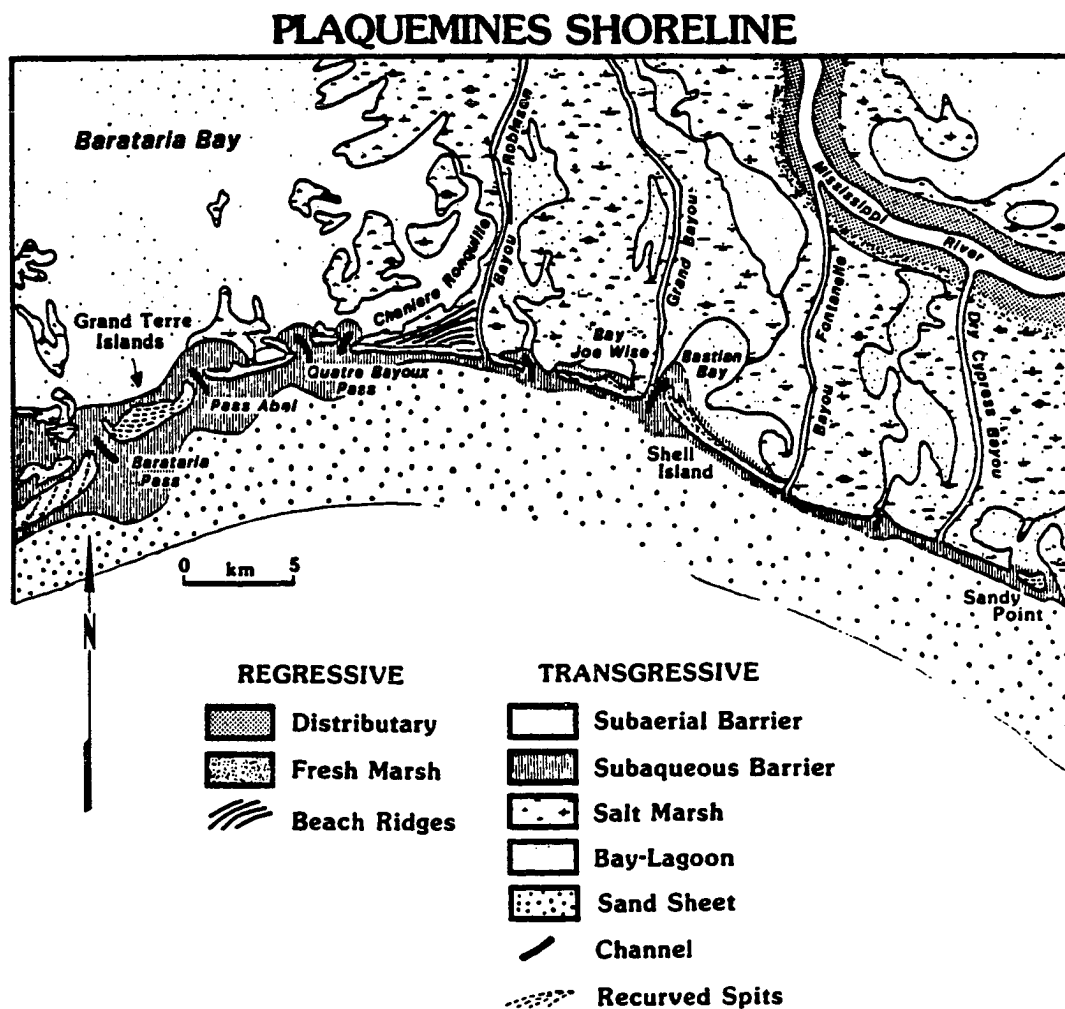


Figure 110. Map of Plaquemines shoreline including Grand Terre. In older aerial photos the beach ridge orientation on Grand Terre suggests that it grew from eastward located sediment sources.

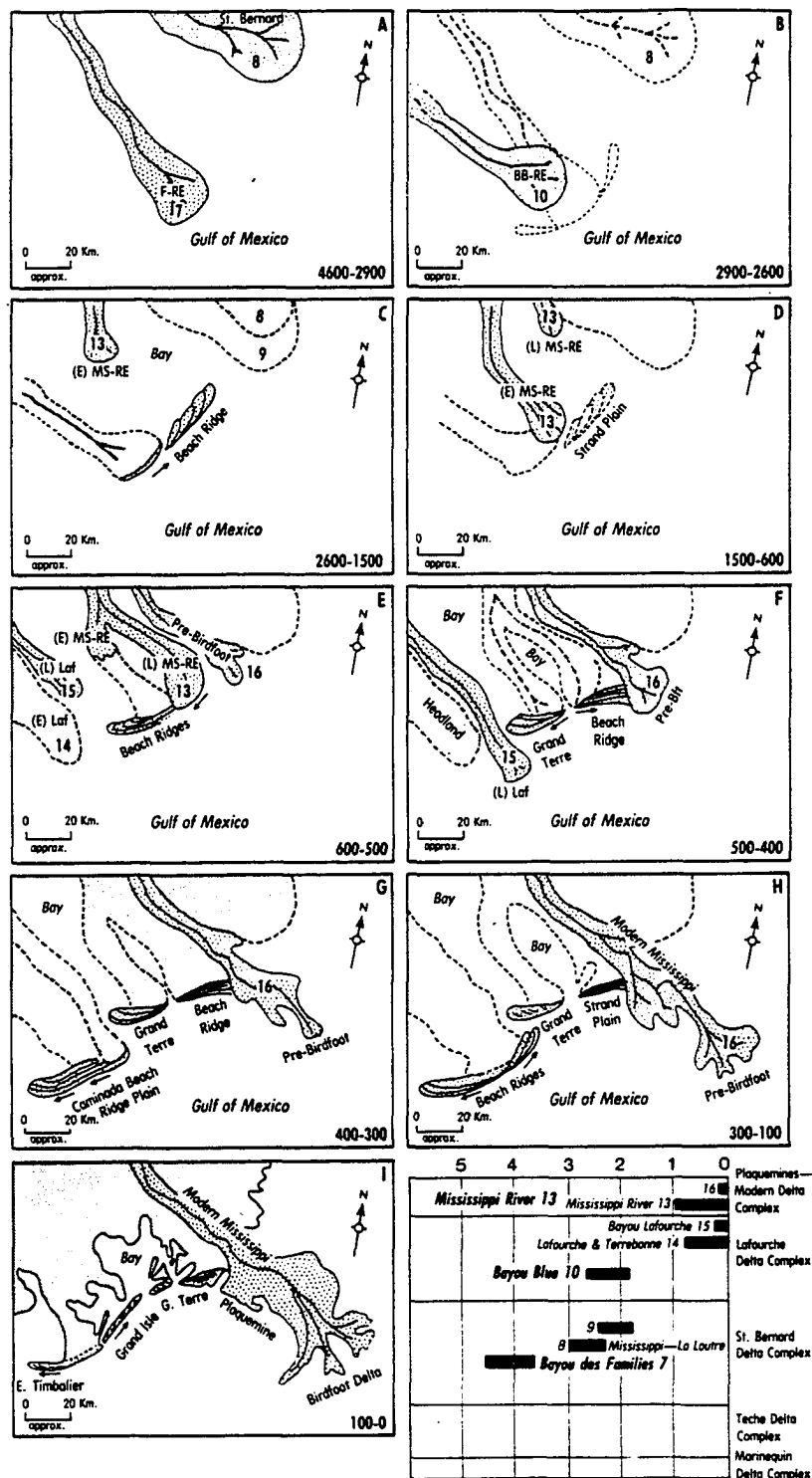


Figure 111. Summary diagram of delta lobe chronology in the Barataria Vicinity 5000 ybp to present.

### **Modern Barataria Shoreline Transgression**

The Barataria region has been in a transgressive state for the past several hundred years. The shoreline is eroding landward at rates exceeding 10 m/yr (Figure 112) (Mossa et al., 1985), the bays are expanding and passes have evolved to tide-dominated morphologies. The transgression is resulting in an influx of sands into the bays and passes. Flood-tidal deltas have formed within each of the passes. Expansive ebb-tidal deltas dominate the nearshore Barataria region. The sands of the ebb-deltas are observed in the offshore profiles between -4 m and -3 m (the sediment/ water interface).

On an average the Barataria barrier thickness is less than 1 meter and overlies backbarrier marsh. As a result the Modern barrier sands are rapidly transgressing the backbarrier and filling the shallow, landward bays. Channel fill on the west side of Pass Abel is the only location where modern barrier sands exceed that thickness.

### **CHRONOLOGY OF TRANSGRESSIONS AND REGRESSIONS**

The chronology of delta lobe progradations and transgressions has been determined by the integration of several factors. Carbon-14 dates, stratigraphic interpretations, and use of present rates of shoreline erosion (Figure 111).

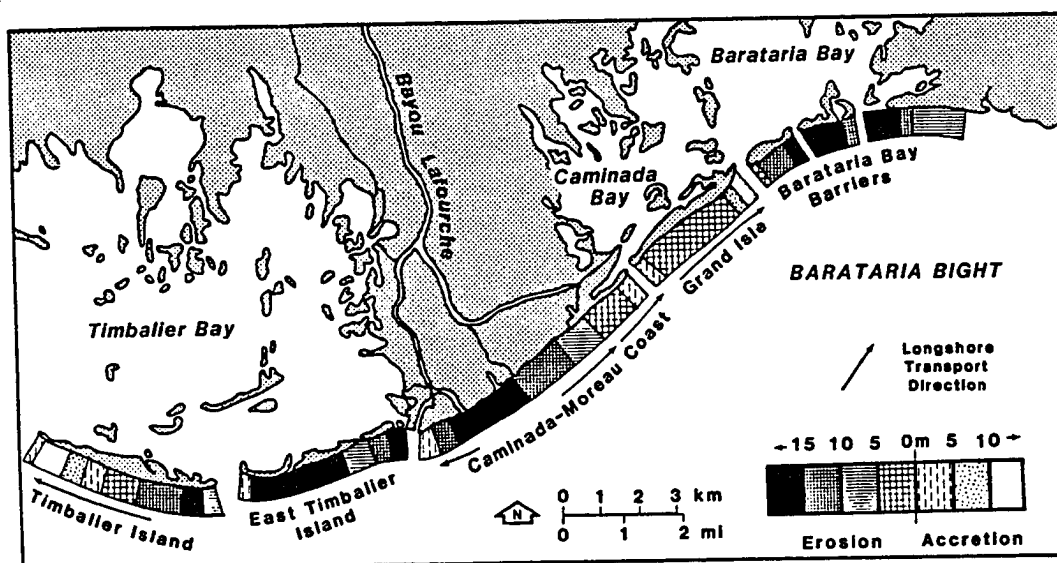


Figure 112. Present rates of shoreline change along the Barataria shoreline (From Mossa et al., 1985).

The chronology was based upon the known occurrence of the Bayou Blue progradation. Carbon-14 dates and stratigraphy confidently identified the period of activity of the Bayou Blue delta lobe between 2600 and 1900 ybp. The following presentation is not sequential, rather it details the justification for determining when each regression and transgression occurred. Following this, the ordered sequence will be presented.

### **Bayou Blue Transgression**

Interpretation of the offshore seismic records and cores projected the seaward limit of this progradation to 9 km offshore of the present shoreline. The Bayou Blue transgression ceased approximately 1 km landward of the Barataria shoreline (Figure 113). The total transgression covered a distance of 9 km. Coastwise, this transgression affected the entire 45 km stretch between the Caminada Moreau Headland and Chenier Ronquille. The regional aspect of this transgression suggests that sea level was rising during this period of time.

Erosion rates along the transgressive shoreline in the Barataria shoreline area range from 5 to 20 m/yr (Figure 112) (Mossa et al., 1985). Using a conservative average of 10 m/yr, the 9 km of shoreline retreat experienced during



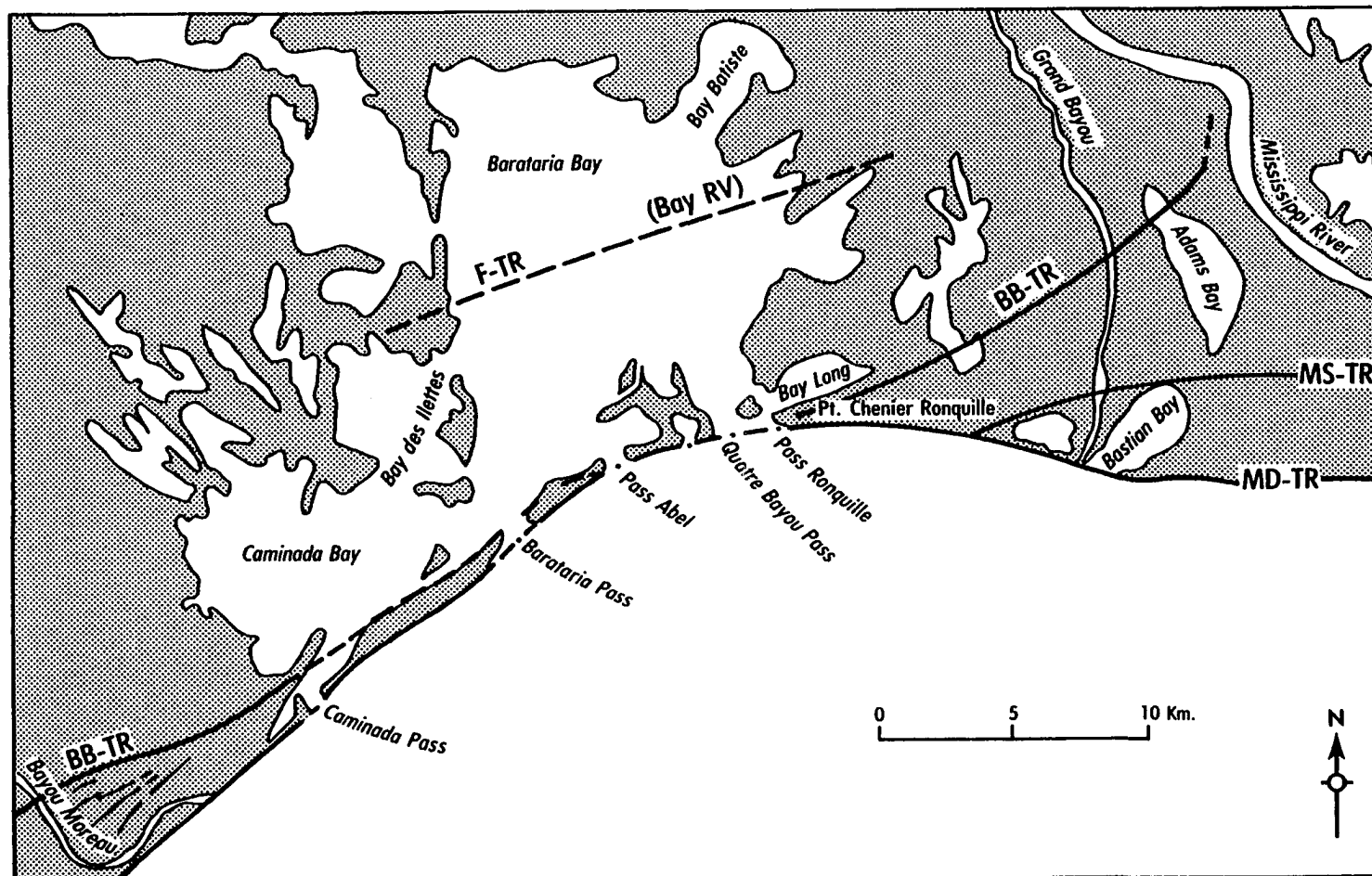


Figure 113. Landward limits of transgressions occurring in the Barataria Bight region. The Families transgressive limit is interpreted to be a bay ravinement surface. The Bayou Blue transgressive limit is positioned slightly landward of a related barrier shoreline. The Mississippi/Modern transgression contact is the present shoreline.

the Bayou Blue Transgression would have occurred in 900 years (Table 3), between 1900 and 1000 ybp.

**Table 3: Duration and Distance Covered by Transgressions**

| Transgression | Seaward<br>limit | Landward<br>limit | TR Rate | Duration |
|---------------|------------------|-------------------|---------|----------|
| Bayou Blue    | 8km              | -1km              | 10 m/yr | 900 yrs  |
| Mississippi   | 6km              | 0 km              | 10 m/yr | 600 yrs  |

### **Mississippi Lobe Progradation**

Two C-14 dates correlated to the western portion of the Mississippi River Delta Lobe ranged in age from 850 to 710 ybp (Figure 108). Carbon 14 dates taken from the eastern side of this distributary lobe deposit within Bay Long indicate that it was probably active between 500 and 200 ybp. Active sedimentation in the eastern region of Chenier Ronquille may have slowed the Mississippi Transgression but probably did not reverse the trend. Based upon the termination of the Bayou Blue transgression at 1000 ybp and the C-14 dates, a conservative range for the Mississippi Delta Lobe activity is between 1000 and 300 ybp.

### **Late Lafourche Progradation**

Gerdes (1985) dated the beach ridge at Caminada-Moreau at 700 ybp. This date marks the inception of the Late LaFourche Progradation. He estimated that this delta lobe was active until approximately 400 ybp (Figure 111).

### Mississippi Lobe Transgression

The seaward limit of the Mississippi Delta lobe growth is difficult to estimate because offshore evidence has been removed by shoreface erosion. Based on its lower contact lying at -4 m (Figure 77) its seaward limit of growth is estimated to that isobath on present charts, approximately 6 km from the present shoreline. Welder's (1959) seaward strand plain (Figure 5) represents material that was eroded from the abandoned lobe of the late Balize Lobe that built against the prograding modern delta channel (Figure 111). The modern shoreline retreat represents later stages of the Mississippi transgression. Based on a 10 m/yr rate of erosion (Mossa et al., 1985) over a distance of roughly 6 km, this overall transgression spanned 600 years (Table 3) between 600 ybp and the present.

### Bayou des Families Transgression

The time-frame in which the Bayou des Families Transgression occurred is difficult to estimate. The inception date of the Bayou Blue Regression (2600 ybp) does not necessarily mark the end of the Bayou des Families Transgression. In fact, the Families Transgression must have continued until Bayou Blue had buried the bay ravinement and began emptying directly into the Gulf. The arrest of the Families transgression also supposes that the sediment influx of Bayou Blue was of sufficient quantity to halt it. There is not enough stratigraphic evidence to determine the

age of this transgression or the age of the Bayou des Families Regression. Based upon the limited data derived from this study the average transgression probably lasts on the order of 1,000 years. This would place the Bayou des Families Transgression between 3600 and 2600 ybp.

#### **Bayou des Families Regression**

By working backwards, and using a general rule of thumb that active delta lobes in the Mississippi River delta plain have a longevity of 1000 years (Kolb and Van Lopik, 1966; Penland and Boyd, 1985) a crude estimation for the occurrence of Bayou des Families can be suggested. The Bayou des Families progradation probably occurred between 4600 and 3600 ybp.

#### **Recent Delta Progradations Along the Barataria Shoreline**

The orientation of the Barataria shoreline has been noted as enigmatic for the delta plain. All other barrier shorelines along the Louisiana barrier shoreline are crescentic (Dolan et al., 1974) with the apex of the curvature at the most seaward point in the system (concave landward), for example, the Chandeleurs, Isles Dernieres, and Timbalier Islands (Figure 114). The only portion of the transgressive Louisiana shoreline where this convention is not observed is in the Barataria region. Grande Isle, Grande Terre and the Chenier Ronquille area form a

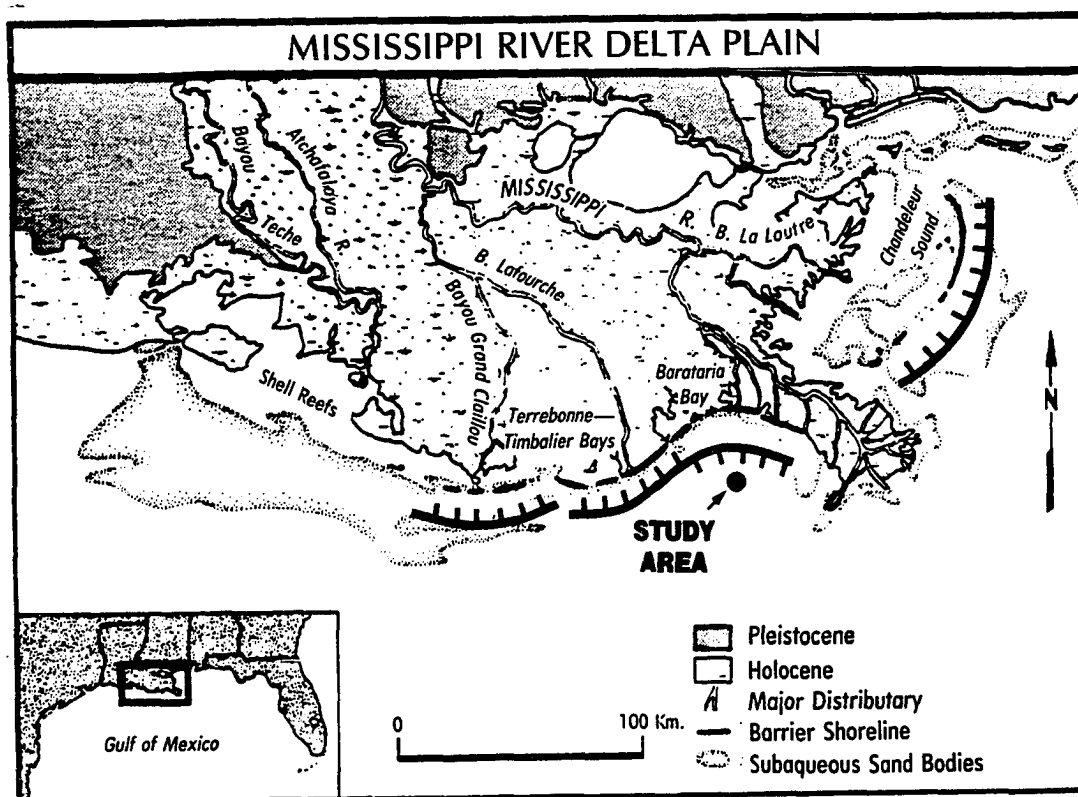


Figure 114. The Mississippi Delta Plain. With the exception of the Barataria Bight region all other transgressive portions of this shoreline are concave (the apex of the curvature pointed landward).

shoreline that is more aptly described as a bight. The Mississippi Lobe, Late Lafourche and Plaquemines/Modern progradations all contribute to this shoreline configuration.

According to Frazier (1967) the late Lafourche and Mississippi delta lobes prograded into the Barataria Basin area at the same time. Both probably constructed wave dominated deltas (Gerdes, 1985). The Late Lafourche delta was responsible for the formation of the Caminada Moreau Headland. Grand Terre barrier and Chenier Ronquille are products of the Mississippi Delta lobe. This contention is supported by the shape of Barataria Bay shown on historical maps. Maps dating back to the 18th century, though admittedly general and undetailed, depict Barataria Bay as an elongate body of water that widened landward (Figure 115). Leach and Turtle published a detailed map in 1887 that shows relict distributaries of two distinct lobes; one from the northwest and the other from the northeast intersecting with the main trunk of the Mississippi River. The age and location of these delta lobe correspond to the late Lafourche and Mississippi delta lobes. Prior to the outgrowth of these delta lobe the area presently known as Barataria Bay was a much larger interdistributary area (Figure 116).

Initially, the Mississippi River Lobe prograded into

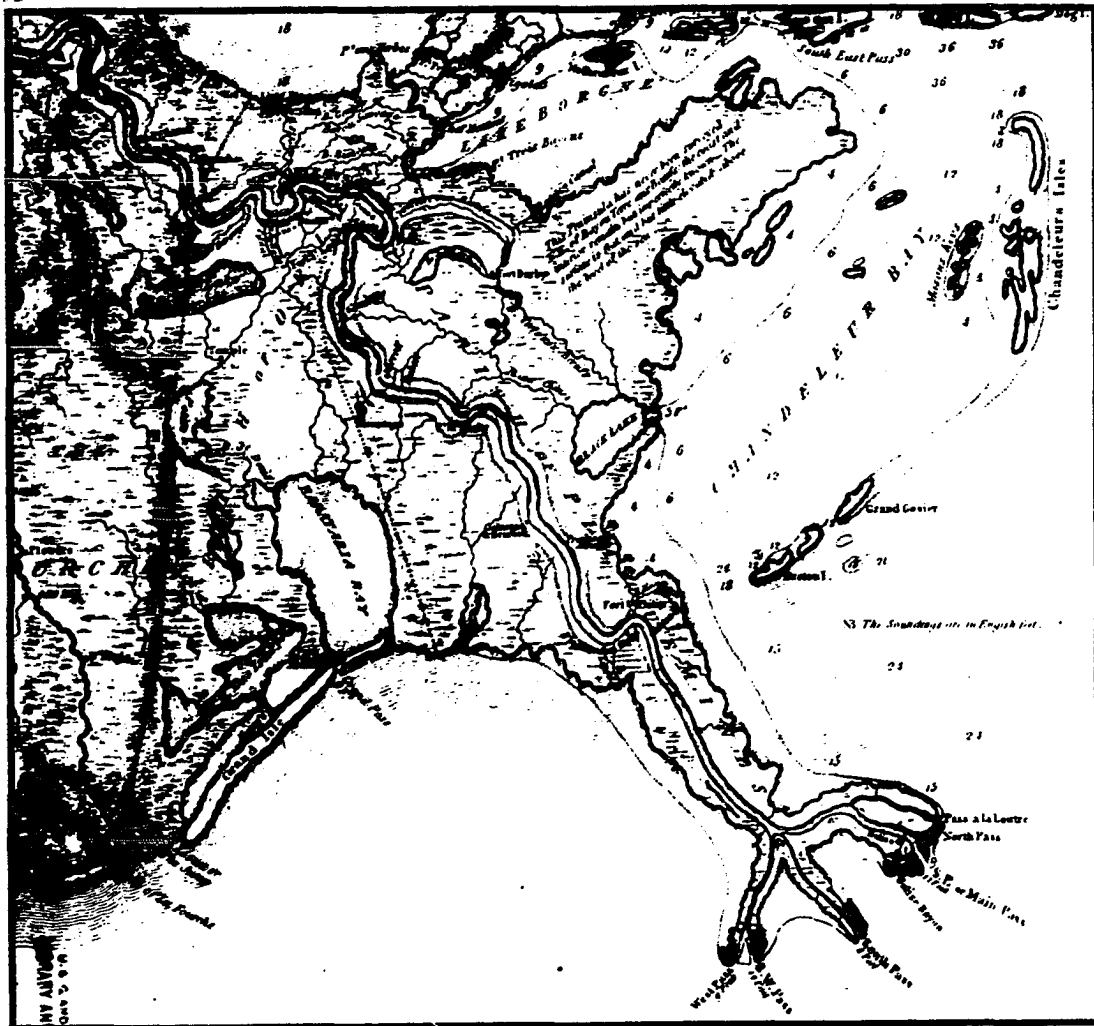


Figure 115. 1816 map of southeastern Louisiana, Barataria Bay. The north/south elongate shape suggests that it is located between two narrow delta lobes. There is no opening in the area where Pass Abel is now located.

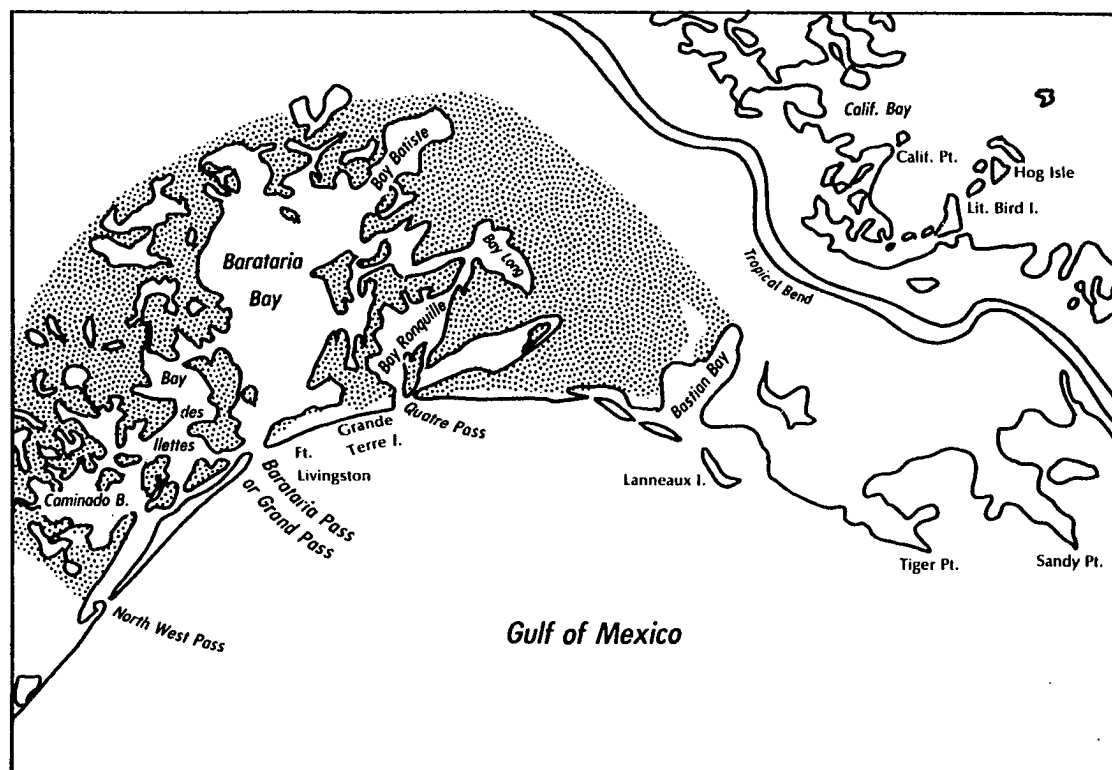


Figure 116. Barataria Bay prior to the Mississippi and Late Lafourche progradations.



the eastern side of Barataria Bay and was abandoned (Figure 111). Beach ridges that grew from the abandoned headland are preserved in Grande Terre Barrier Island. During the later stages of the Mississippi Lobe progradation the Late Lafourche delta lobe began to build along the west side of what is now known as Barataria Bay (Figure 111). When this delta passed the seaward shoreline, its sediments were transported to the west creating the Bayou Lafourche/Caminada Moreau beach ridge system (Gerdes, 1982). Gerdes (1982) concluded that they formed between 800 and 300 ybp. Once the Late Lafourche headland was abandoned, marine processes attacked the headland building the Timbalier Islands to the west and Grand Isle to the east (Figure 117). Grand Isle grew towards Grande Terre, forming Barataria Pass between them. The Barataria Bay area was smaller at that time and tidal currents in the newly created inlet would have been less dominant. Sand introduced into the pass system via easterly longshore sediment transport would have bypassed the inlet and renourished Grande Terre (Shamban, 1985). The renewed sediment supply to Grand Terre resulted in the present shoreline reorientation. The melding of the Grande Isle flanking barrier with the Barataria shoreline system transformed a coastline of opposing flanking barriers to a transitional, shoreline bight. The building of sub-deltas to the west of the Modern Delta (i.e. Bayou Robinson)

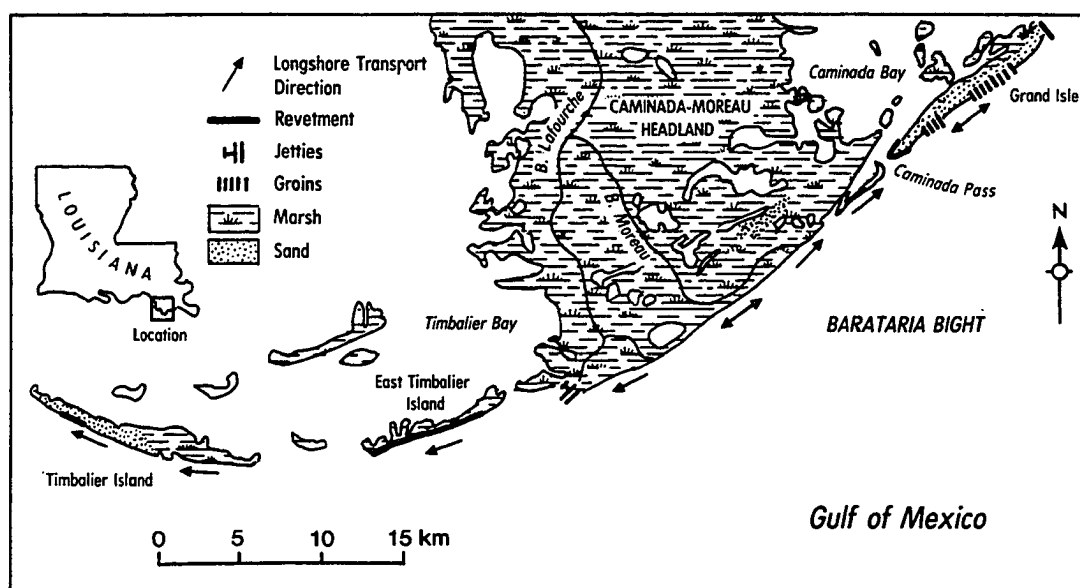


Figure 117. Longshore sediment transport trends in the vicinity of the Caminada Moreau headland (from Gerdes, 1985).

contributed further to the formation of the Barataria shoreline bight configuration (Figure 111).

#### **SUMMARY OF BARATARIA GEOLOGIC HISTORY**

At least three delta progradations have directly contributed to the Barataria geologic framework, Bayou des Families, Bayou Blue, and the Mississippi Delta Lobe. These delta lobes are separated by transgressions each lasting nearly a thousand years. Table 4 collates the occurrence of regressions and transgressions that have contributed to the geologic framework in the Barataria Bight region.

A comparison of this lobe chronology with Frazier's (1967) study reveals significant differences (Figure 118). The Bayou des Families lobe period of activity is suggested, by this study, to have occurred between 4600 and 3600 ybp. Frazier's diagram places it between 3600 and 2000 ybp. Stratigraphic data from the Barataria area shows clearly that a transgressive episode took place between the des Families and Bayou Blue progradation. The age of Bayou Blue lobe is between 2600 and 1900 ybp. Considering the projected time period for the des Families transgression at 1000 ybp, the late limit for the des Families progradation is 3600 ybp. Figure 111 illustrates the chronology of the Barataria shoreline region deposited over the past 5 thousand years.

The longevity of the Bayou Blue regression determined from this data set (500 yrs) is more realistic for the size

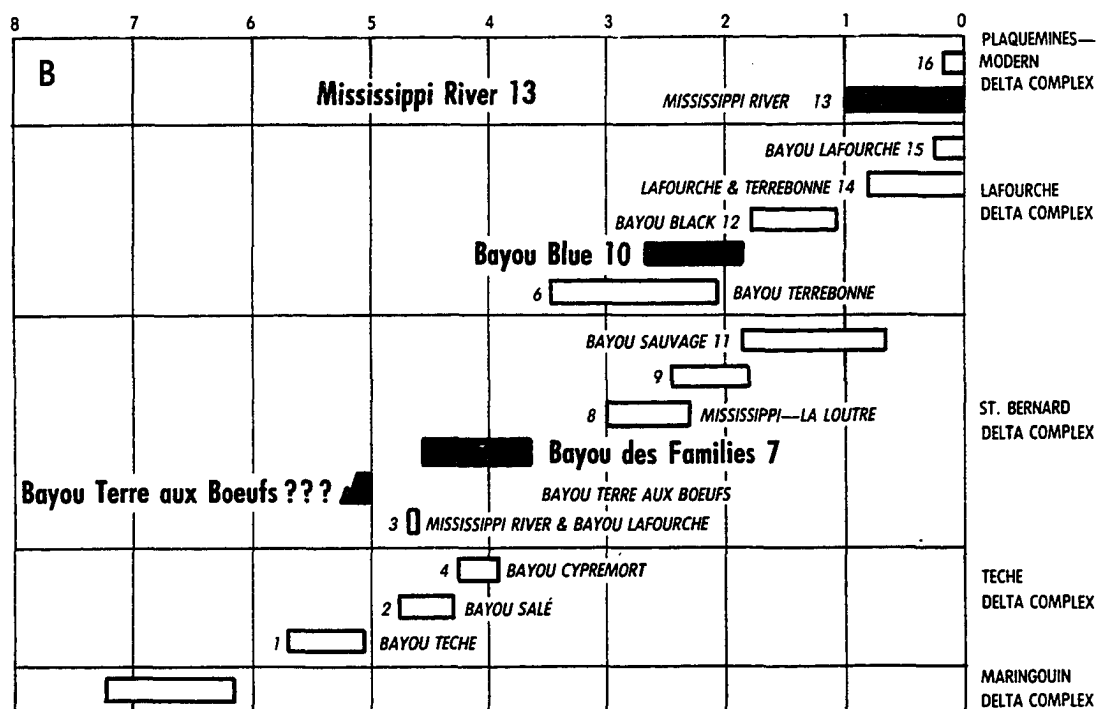
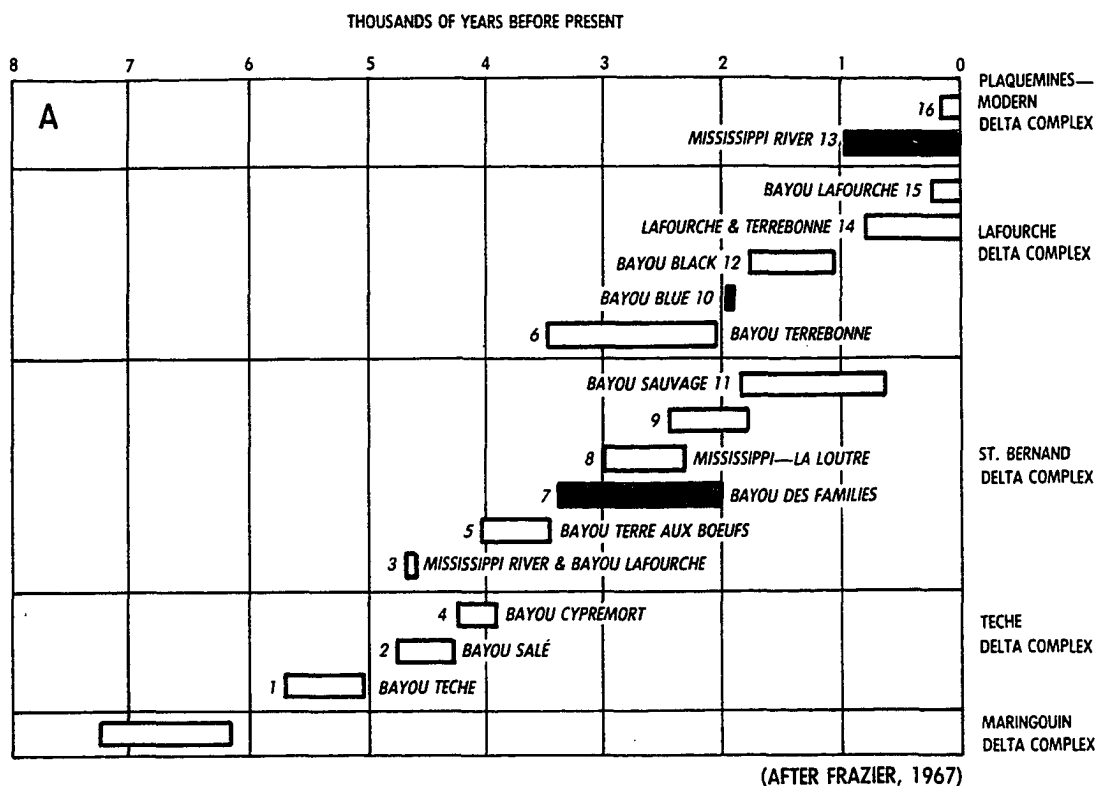


Figure 118. Comparison between Frazier's delta (1967) lobe chronology and the new chronology, modified by this dissertation research.

of this delta lobe than the limited (100 yrs) period of activity depicted by Frazier. Frazier's estimation of the abandonment of the Bayou Blue progradation is consistent with findings from this research. In fact, Frazier's (1967) chronology agrees well with the later delta lobe chronologies (1000 ybp to present) determined with the newer stratigraphic information gathered from the Barataria area. Frazier depicts the Bayou Blue transgression as occurring between 1970 and 900 ybp. This is consistent with the findings in the current research. Both data sets concur that the Mississippi lobe progradation occurred between 1000 ybp and the present.

#### **CONCLUSIONS REGARDING BARATARIA GEOLOGIC HISTORY**

1. The early chronology of Bayou Des Families, and Bayou Blue should be modified to reflect the chronologies determined from this study. The Mississippi Lobe should be recognized as having an early and late phase.
- 2) The seaward limit of the Bayou des Families Transgression cannot be ascertained from this data set. The landward limit of the bay ravinement limit lies 9 km landward of the present shoreline. The regional extent of this shoreline retreat cannot be evaluated.
- 3) The Bayou Blue Transgression limit was located 1 km landward of the present shoreline. This transgression can be traced from the Caminada headland to the northeast where it

is lost beneath the present path of the modern Mississippi River channel. This shoreface retreat appears to have been regional, affecting shorelines away from the influences of the Bayou Blue progradation.

4) Grand Terre is part of a strand plain formed during the abandonment phase of the Mississippi Delta Lobe Progradation. Grande Isle is younger than Grand Terre, and was formed following the Late Lafourche delta progradation.

**Table 4: Summary of Barataria Geologic History**

| <b>DELTA LOBE</b>    | <b>AGE</b>      | <b>DURATION</b> |
|----------------------|-----------------|-----------------|
| -----                | -----           | -----           |
| Terre aux Boeuf (??) | ???? -4600 ybp  | ???????         |
| des Families Re      | 4600 - 3600 ybp | 1000            |
| des Families Tr      | 3600 - 2600 ybp | 1000            |
| Bayou Blue Re        | 2600 - 1900 ybp | 700             |
| Bayou Blue Tr        | 1900 - 1000 ybp | 900             |
| Mississippi Lobe Re  | 1000 - 200 ybp  | 800             |
| * Plaquemines Re     | 500 - 200 ybp   | 300             |
| Late Lafourche Re    | 700 - 400 ybp   | 300             |
| Mississippi Tr       | 200 - 000 ybp   | 200             |
| -----                | -----           | -----           |

\* A sub-lobe of the Mississippi Lobe Regression

## 9. HOLOCENE SEA LEVEL CHANGE IN THE MISSISSIPPI DELTA REGION

### INTRODUCTION

The geologic architecture of the Barataria Bight has been constructed by a series of delta lobe progradations and transgressions. The exact formation is controlled by rates of sediment supply, subsidence, rates of shoreface retreat and eustatic changes in sea level. The Barataria cross-sections have been used to document the relative influence that each of these factors have had on the area geologic history over the past 5000 years.

#### Relative Sea Level Rise

Present rates of sea level rise along the Mississippi River delta plain have been determined by a number of researchers. Methods include radiocarbon dating of buried, in-situ peats (Frazier, 1967; Gerdes, 1982; Penland et al., 1987a; 1987b) and short term analysis of tide gauge data (Boesch et al., 1983; Ramsey and Moslow, 1987). Short term rates in the Barataria area, measured at Bayou Rigaud, indicate a recent rate of sea level rise approaching 1.2 cm/yr (Figure 119) (Swanson and Thurlow, 1973). This rate is comparable to a value of 1.0 cm/yr calculated from widely spaced delta plain tide gauges by Ramsey and Moslow (1987) and 0.85 cm/yr determined by Conner and Day (1988) for the Barataria region. High rates of relative sea level rise experienced in the near surface sediments (0 to 1 m) are

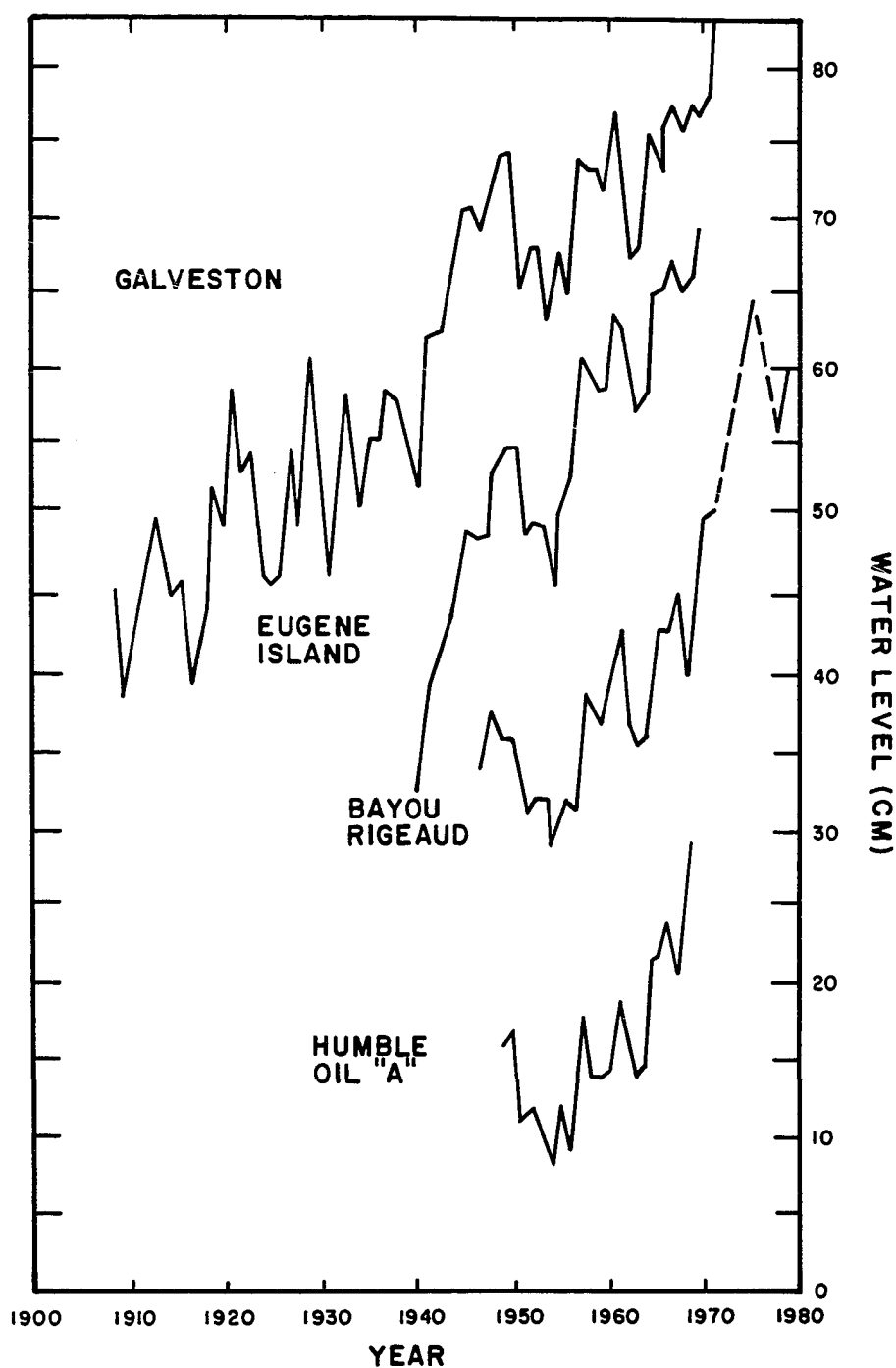


Figure 119. Sea Level rise measured at the Bayou Rigaud tide gauge in the Grand Isle vicinity from 1950 through 1980. Sea Level rose at a rate of 1.5 cm/yr during this time period.



short term (<200 yrs) and probably controlled by compaction of the delta plain sediments. Kusters (1987) concluded that 70 to 80 per cent of the early subsidence is caused by sediment dewatering.

The high rates of relative sea level rise presently being experienced are not recorded in the subsurface below -1 m msl. Long term rates of subsidence (>200 years), a process that dominates relative sea level change in Louisiana (Nummedal, 1983), are significantly lower than those reported in recent years. Gerdes plotted C-14 dates against depth of burial for samples taken from the Caminada Moreau headland. From these data he calculated a longterm rate of subsidence on the order of 0.27 cm/yr. Il (1987) calculated a slower long term rate of subsidence of 0.134 cm/yr for the St. Bernard Delta Lobe. Other researchers (Frazier, 1974; Nummedal, 1983) also concluded, and others (Penland et al., 1987b) suspected that rates of subsidence decrease with depth.

In the Barataria cores the average rate of sea level rise calculated in samples recovered from shallower than -2 m msl is 0.7 cm/yr. From 2 - 4 m the overall rate of sea level rise decreases to 0.29 cm/yr. This rate agrees with the 0.27 cm/yr rate determined by Gerdes (1985) from Caminada Moreau headland samples lying shallower than 5 m msl (Figure 120). A relative sea level rise of 0.17 cm/yr was calculated from the lone Barataria in-situ sample taken

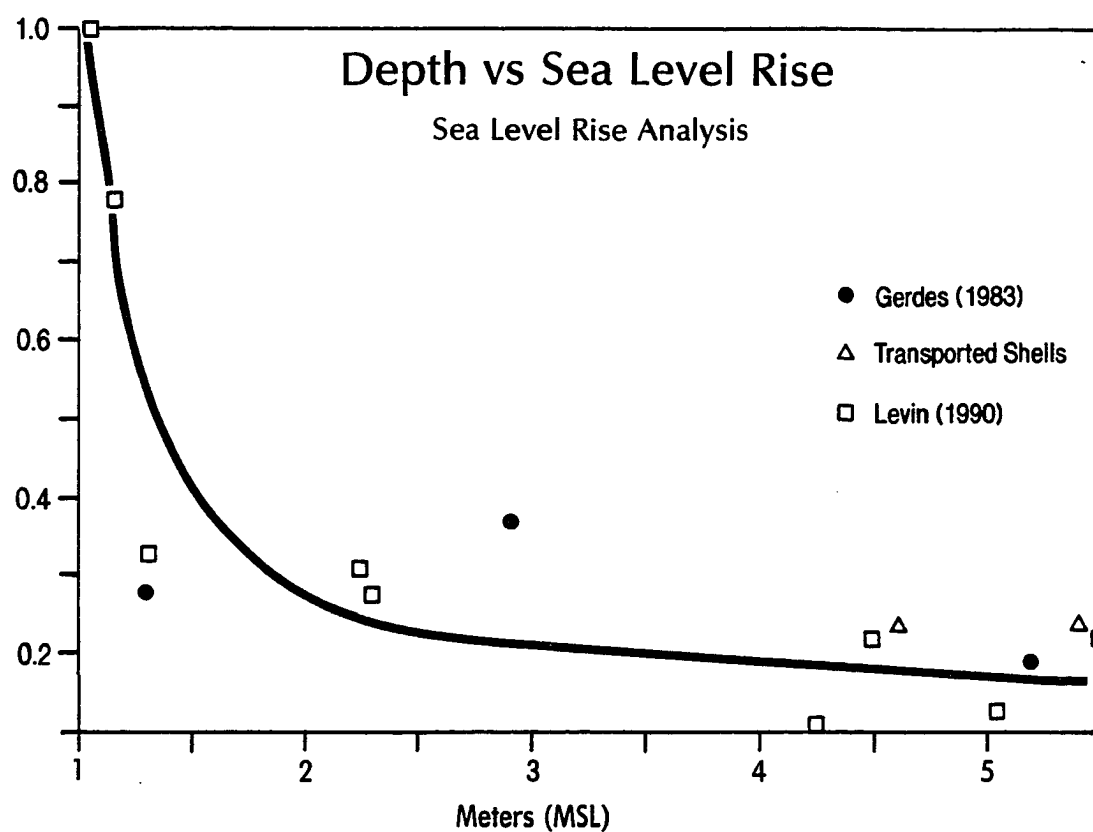


Figure 120. Plot of C-14 dates taken from the Barataria/Caminada shoreline area vs. depth. The curvilinear trend of the Barataria Bay samples suggests that rates of subsidence decrease with depth.

below -4 m. Though the total sample size is small, the results suggest that the accelerated rates of relative sea level rise, in excess of 1.0 cm, reported along the Mississippi Delta Plain are short term and concentrated in the near surface sediments. This conclusion is also supported by the chronology and thickness of the delta lobes observed in the Barataria bight area.

The surface of the Bayou Blue delta lobe has a transitional contact with the Mississippi Delta lobe above at -4.0 m (Figure 83). Assuming an abandonment date of 1950 ybp, at a nominal depth of 4.0 m, this calculates to a longterm subsidence rate of 0.20 cm/yr. Using the subsidence rate of 0.2 cm/yr, and the C-14 date of 2440 ybp calculated for the Spartina sp. sampled from beneath core CR-5 in the Bayou Blue lobe, the expected depth of burial would be 4.88 m. The actual depth of occurrence is slightly more than 5.00 m. Based upon these calculations, the rates of subsidence presently observed in the surface sediments abate with depth.

Two hundred and thirty five Carbon-14 dates reported by Frazier (1967) and Smith et al. (1986) were plotted against depth of burial (Figure 121). The curvilinear trend shows that the average rate of sea level change has decreased through time. From 9 to 6 ka the average rate of subsidence was 0.55 cm/yr. From 6 ka to 4 ka the rate dropped to 0.35 cm/yr. Between 4 ka and the rate of apparent

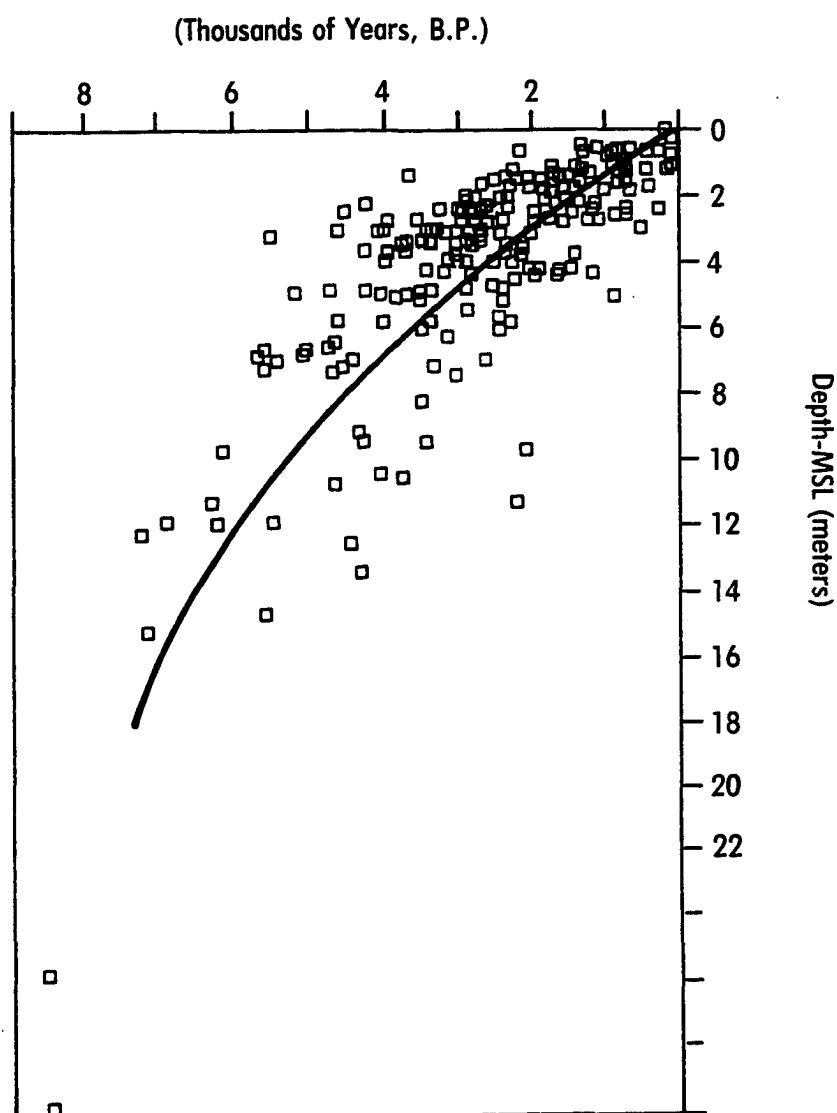


Figure 121. Plot of 235 C-14 dates vs. depth for samples taken from the Mississippi River delta plain. The curvilinear trend of these data match that of the small dataset collected for the Barataria study.

subsidence decreased to an overall rate of 0.15 cm/yr.

Depthwise, the relationship between depth of burial with age fell off at depths shallower than -1.0 m (msl) (Figure 122). This variance is probably related to regional differences in geologic history which contributes to rates of sediment compaction and subsidence.

### **Eustatic Sea Level Changes in the Gulf of Mexico**

It is hypothesized that eustatic change in sea level within the Gulf of Mexico has had some affect on the stratigraphic framework of the Mississippi Delta lobe. Unfortunately, no reliable sea level curves have been produced for the Gulf of Mexico. Tanner et al. (1989) drew a late Holocene Gulf of Mexico sea level curve that relied heavily on changes in beach ridge height and orientation, and four C-14 dates from St. Vincents Island. The methodology used in that research to interpolate sea level fluctuation is suspect. Numerous sea level curves have been published using data from various regions worldwide (Milliman and Emery, 1968; Frazier, 1974; Rhode, 1978; Colquhoun et al., 1981; and others). Recent inquiries regarding a reference for the most reliable, high resolution sea level curve for the past 5000 years was met with dry humor. The response was "You can pick a sea level curve to show anything you feel will support your stratigraphic story" (A. Bloom, personal communication). A literature review

## DEPTH VS SUBSIDENCE

C-14 DATES in MDRP

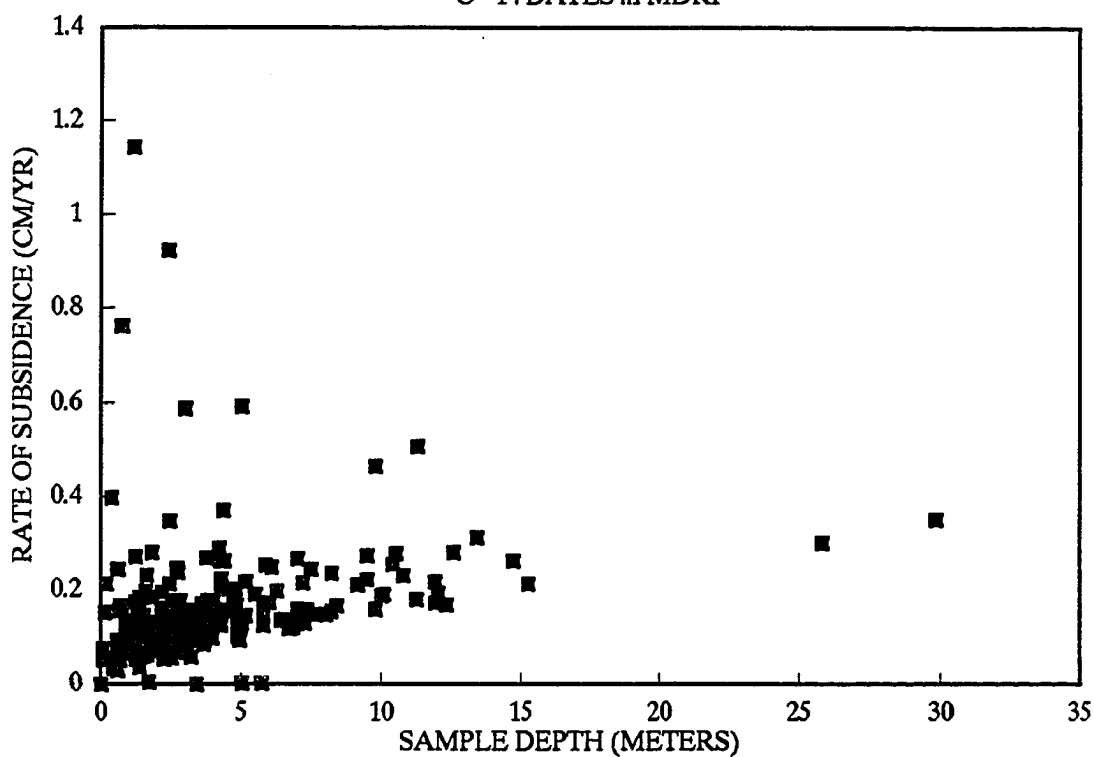


Figure 122. Plot of apparent rates of subsidence vs. depth. At depths <1 m variance is the greatest. This plot suggests that regional differences in surficial geology contribute to high initial rates of relative sea level rise.

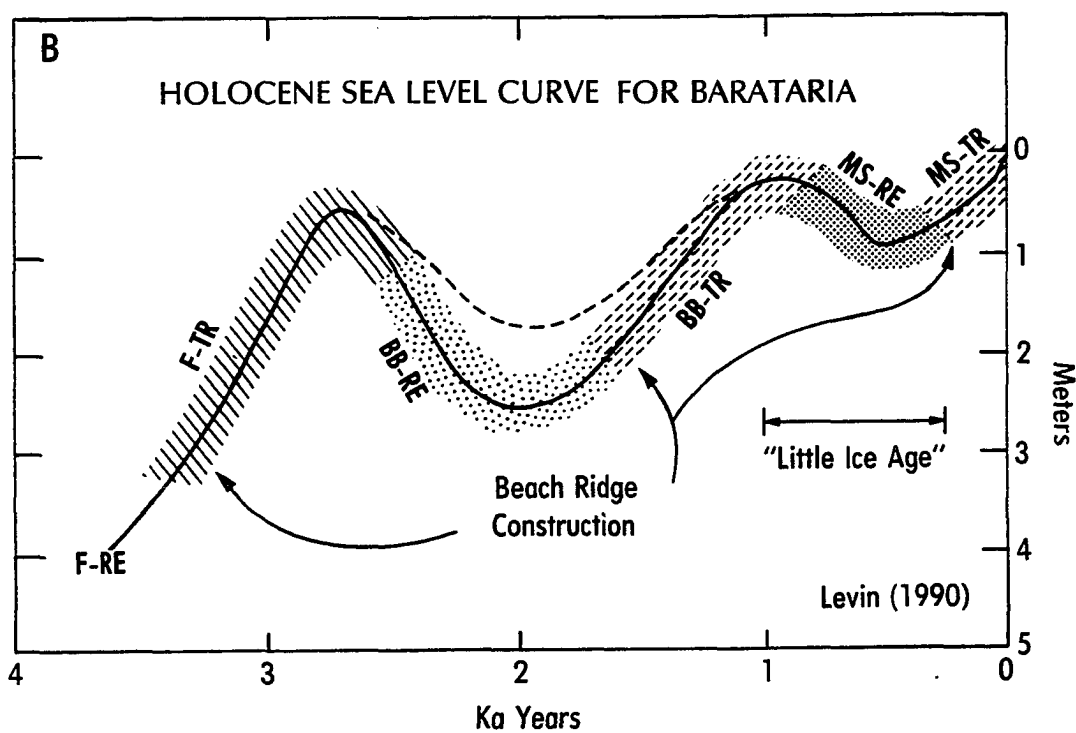
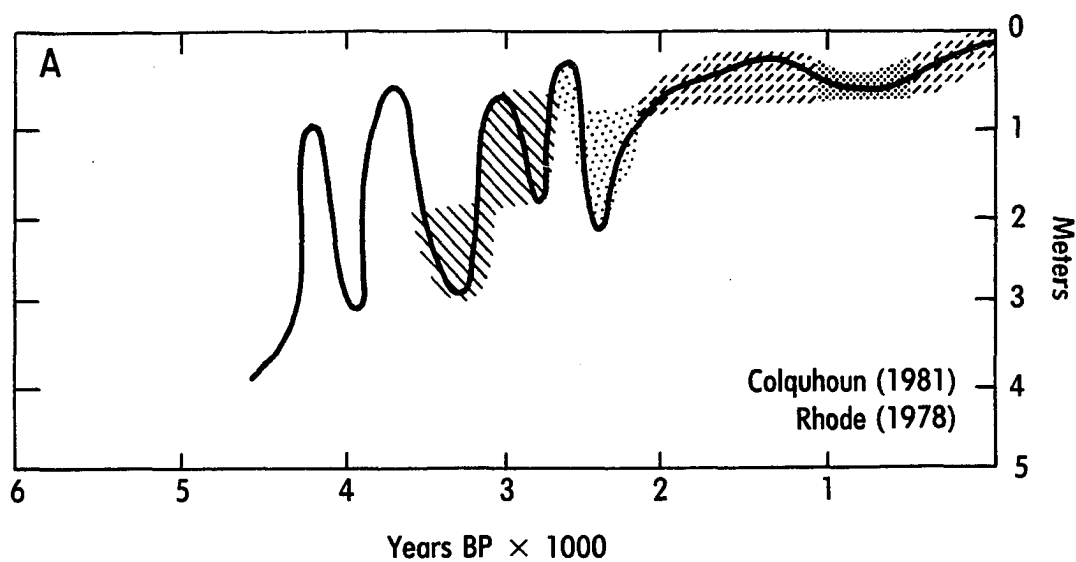
by Tanner et al. (1989) reached the conclusion that the amount of published information regarding sea level fluctuation in the Holocene is dizzying, the results confusing, and impossible to directly correlate to the recent stratigraphic column.

### Objectives

In this chapter stratigraphic interpretations using techniques of sequence stratigraphy (Vail et al., 1977) are used to construct a sea level curve for the Barataria area. The data package used to formulate this curve includes a series of bay ravinement/flooding surfaces, known periods of delta lobe progradations and regionally mapped transgressions. Sea level fall is implied using stratigraphic sequences of stacked, channel units. According to Van Wagoner et al. (1987) lowering sea level may be recorded stratigraphically by contemporaneous downcutting of the distributary channels into the lower units. However, it is difficult to make absolute conclusions about sea level fluctuation based solely on channel stratigraphy in an area where channel depth changes are not only the result of fluctuating sea level, but due to temporal changes in discharge. A later chapter will demonstrate that tidal inlet enlargement can cause channels to incise tens of meters into the underlying substrate in a relatively short period of time. The primary objective of this dissertation chapter is to present evidence for a sea level

curve for the Barataria area using sequence stratigraphy (Vail et al., 1977) and inference from other data sources. This curve will then be compared to sea level curves constructed along (presumably) stable geologic coasts to determine whether the timing, amplitude and frequency of sea level change are within reasonable agreement with other researchers. For example, a sea level curve published by Colquhoun et al. (1981) for the Carolinas (Figure 123) shows several periods of sea surface oscillation with frequencies of several hundred years and amplitudes of up to 2 m. This curve covers a time span between 4500 and 1800 ybp. A german based sea level curve depicts (Figure 123) alternating sea level rise and fall over the past fourteen hundred years (Rhode, 1978). Rhode's (1978) curve shows a 0.5 m drop in sea level that is correlated to the "little ice age" occurring between 900 and 500 ybp. It is interesting to note that the overall average rate of sea level rise recorded over the past 1500 years in the German based curve is 0.12 cm/yr. A carbon-14 data from the Mississippi River delta plain shows comparative subsidence rates of 0.14 cm/yr over that same period of time. The recent published rates of relative sea level rise in excess of 1.0 cm/yr are incongruous with the rate calculated over the past 4 millenniums. It is hypothesized, that the 0.14 cm/yr is a weighted average of sea level rise and fall over the past 4 ka.





NOTE: Areas shaded with the same pattern represent the same time period

Figure 123. a. Modified sea level curve based upon the joining of Colquhoun (1981) and Rhode (1978) data. b. Late Holocene sea level curve for the Barataria Region of Louisiana derived from the dissertation data.

## **Data/Results**

### **Families Regression**

The central axis of the Bayou des Families appears from Frazier's (1967) estimation to lie within the eastern Barataria shoreline in the Pass Abel/Quatre Bayou Pass area (Figure 111). This progradation is at least 12 m thick (Figure 77), several meters thicker than either the Bayou Blue or Mississippi Lobe progradation. The seaward terminus of the Families lobe could not be established by this research. However, using seismic information, Moslow and Levin (1985) determined that these channels extended offshore over 16 km.

### **Families Transgression**

A clear transgressive surface cannot be found over the Families progradation. Instead, a thin, discontinuous lens of shelly sands and muds separates the Families Re from the Bayou Blue Re (Figures 74 and 76). The lack of shoreface-like truncations of an open marine ravinement surface suggests that the Families lobe was flooded by rising sea level. The contact between the Families and Bayou Blue Re fits the definition of a bay ravinement/ marine flooding surface (Van Wagoner et al., 1987). The true open marine shoreface and ravinement surface was located considerably further seaward than this data reaches.

### Sea Level Changes During The Bayou Des Families Delta Cycle

The onshore portion of the Bayou des Families delta lobe was also sampled by this program. This conclusion is supported by the presence of a bay ravinement that overlies a maze of distributary channels separated by overbank, interdistributary bay and delta plain marsh facies. This delta lobe probably built into the Gulf when sea level was considerably lower than it is today (Figure 123). Coleman and Smith (1964) concluded that sea level was 6 m lower than at the present approximately 7000 ybp. Following progradation of the des Families lobe a rapid rise in sea level occurred. This is confirmed stratigraphically by the identification of the marine flooding surface on top of the des Families parasequence. Analysis of subsidence rates within the 7 ka range shows a relatively rapid rate of sea level rise, on the order of 0.55 cm/yr occurring within the Mississippi Delta Plain at this time (Figure 121). Marine flooding surfaces are formed when sea level rises rapidly (Van Wagoner et al., 1987).

Rising sea level may also cause aggradation in channels. The thickness of the active channel facies in core 37 (Figure 77) suggests that aggradation did occur during this phase of delta lobe construction. Downward cutting of upper channels may be caused by lowering sea level or increased distributary discharge. Several incidents of channel incision may be inferred from core 37 and 38 (Figure 72).

Conclusions regarding possible lowering of sea level based upon channel scour are inconclusive. However, based upon the relatively rapid rate of relative sea level rise experienced in the delta plain during this period of time, any sea level falls were probably masked by the overall rise.

### **Bayou Blue Regression**

The Bayou Blue progradation is contained between -9 and -2 m on the western, Pass Abel, side of the study area (Figure 123). To the east the top of Bayou Blue drops to -3 m. This dip may occur because the depocenter of Bayou Blue was located to the west.

The lower confidence stratigraphic section highlighted in cross-section A-A' (Figure 72) in cores 37 and 38 (-12 and -10 m) may be the result of lowering sea level. In core 38, channel sands of distributary origin contact older channel sands at a depth of -12.1 m. According to Van Wagoner et al. (1987) this sequence can occur during a drop in sea level when the corresponding distributary incises into the underlying strata to adjust its slope to the receiving water body. Another possibility is that the upper channel is of tidal inlet origin. This phenomena may also be explained by position in a river system relative to the receiving basin. The Mississippi river shoals from depths in excess of 70 m to sea level at the distributary mouth bar where South Pass issues into the Gulf of Mexico.

The 2 m incision into the lower strata is well within the range of eustatic sea level change recorded by Colquhoun (1981) for the same time period that Bayou Blue was active (Figure 123). According to Colquhoun (1981) sea level fell nearly 2 m between 2600 and 2400 ybp. According to the Barataria delta lobe chronology this corresponds to the inception of the Bayou Blue progradation. Following sea level fall a rise took place between 2400 and 1900 ybp. During this time Bayou Blue was aggrading, but probably not prograding very quickly. In fact, the Bayou Blue sediments that were deposited during the fall in sea level were probably being reworked into shore parallel beach ridges at this time. The Carbon-14 dates from the strand plain preserved in the subsurface of the Chenier Ronquille area are coeval with the inception of sea level rise at 2400 ybp. Apparently, the rate of sea level rise outstripped the delta lobe's sediment supply around 1970 ybp coincident with the inception of the Bayou Blue transgressive phase.

#### **Bayou Blue Transgression**

The Bayou Blue transgression is recorded stratigraphically as a flooded marine surface. An open marine shoreface is not observed directly. However, the barrier sequence located to the east of the Bayou Blue delta lobe is evidence that the open marine shoreface was nearby. The timeframe in which this transgression occurred has been confidently placed between the end of the Bayou Blue

regression and the inception of the Mississippi Re, specifically between 1950 and 1000 ybp. Based upon the joining of Colquhoun (1981) and Rhodes (1978) this time period corresponds to a eustatic rise in sea level (Figure 123). The abandonment of the Bayou Blue distributary system, combined with sea level rise accelerated the rate of coastal retreat during this time period.

### Mississippi Regression

The delta lobe chronology developed in this dissertation concludes that the Mississippi lobe regression took place between 1000 and 200 ybp (Figure 111). The German sea level curve indicates that sea level cycled down and then up during that time period (Figure 123) (Rhodes, 1978). According to this data sea level dropped approximately 1.2 m as a result of the "Little Ice Age" between 900 and 400 ybp.

A drop in sea level during delta lobe progradation should theoretically cause incision of the distributary channels into the underlying substrate. In cross section B-B', core 10, active channel facies of Ms-Re appear to have scoured down into channels correlated to the BB-Re (Figure 74). This is proposed to be the evidence for lowering sea level during the Mississippi lobe construction. It is during this time period that the modern Mississippi River channel became entrenched in its present path.

The turn-around of sea level at approximately 400 ybp is considered a principal contributor to eastward channel

switching of the Mississippi Lobe. The older portion of the Mississippi River lobe drained through the Bayou Johnson/Quatre Bayou Pass area between 1000 and 500 ybp (Figure 111). Shortly thereafter, sea level began to rise creating an interdistributary bay between Quatre Bayou Pass and the modern distributary channel. The late Mississippi sub-lobe began to fill the Bay Long area behind what is now known as Chenier Ronquille. As sea level continued to rise this lobe was abandoned in favor of the modern Mississippi channel. Sediments eroded from the abandoned headland built against the prograding eastern channel forming Welder's (1959) seaward strand plain (Figure 111). The active channel was the precursor to the modern birdfoot delta of the Mississippi River.

### Mississippi Transgression

Today, the relative rate of sea level rise in Louisiana is in the range of 1.0 cm/yr (Conner and Day, 1988; Ramsey and Moslow, 1987; and others). Coupled with the loss of sediment to the deep-shelf as a result of the present path of the modern birdfoot delta the Mississippi River delta plain is presently experiencing an overall period of transgression. Artificial leveeing of the modern channel has further arrested the ability of the river to change course naturally and build new delta lobes. Shoreface retreat along the Barataria shoreline is presently progressing at rates in

excess of ten meters per year.

## DISCUSSION

There is a significant amount of stratigraphic evidence to suggest that sea level has both risen and fallen during the construction of the Mississippi River delta plain. Though channel downcutting can be ascribed to any number of processes (i.e. lowering sea level, increases in distributary discharge, lateral migration of channel thalwegs) , bay ravinement and open marine ravinement surfaces may only be used to infer relative changes in sea level and/or fluctuations in sediment supply.

Techniques of sequence stratigraphy and the delta lobe chronology presented earlier in this dissertation were used to hindcast relative changes in sea level in the Barataria area over the past 5000 years (Figure 123). The stratigraphic framework occurring in the Barataria Bight can be explained using sea level rise and fall. Sea level history derived from this analysis was compared to high resolution sea level curves constructed for the past five thousand years. Overall, agreement between the inferred sea level change for the Barataria area and curves constructed for "stable" coastlines was good (Figure 123). Based upon the stratigraphic interpretation of the Barataria Bight it is likely that cycles of sea level rise and fall, on the order of two thousand years, with amplitudes of 2 meters or



less, did affect the delta plain region.

#### CONCLUSIONS

1. Eustatic rise and fall of sea level in the Gulf of Mexico has contributed to the geologic framework of the Barataria offshore, and likely to the entire Mississippi River delta plain.
2. Rates of subsidence in the delta plain decrease with depth. Near surface rates of subsidence near 1.0 cm/yr decrease to approximately 0.26 cm/yr and 0.14 cm/yr at 3 and 5m depth, respectively.

## 10. INLET EVOLUTION IN THE MISSISSIPPI RIVER DELTA PLAIN

### INTRODUCTION

The morphology of a tidal inlet is the result of multiple, interactive variables. Perhaps the most influential is tidal prism (O'Brien, 1969; Mehta, 1975; Jarrett, 1976; O'Brien and Dean, 1977; Davis and Hayes, 1984), an inlet parameter which, in Louisiana, changes rapidly over time (Gagliano et al., 1981; Salinas et al., 1986). The temporal increase in Louisiana bay tidal prisms is related to high rates of landloss and relative sea level rise. It is hypothesized that this increase in tidal prism promotes increases in tidal currents, and the increase in tidal currents causes inlet morphologies to change in a non-random fashion.

It is the interaction of tidal currents with incident wave energy that controls tidal inlet morphology (Byrne et al., 1975; Nummedal and Humphries, 1978). Wave energies along the delta plain are low and do not have appreciable alongshore variation. The tidal range is also constant. By holding these variables constant along the delta plain, the distribution of various tidal inlet morphologies along the delta plain must then be correlated in some way to bay area and/or tidal prism.

On most coastlines high rates of longshore sediment

transport is the primary cause of sand introduction to an inlet system (Byrne et al., 1975; FitzGerald and FitzGerald, 1977; Halsey, 1979). The inability of tidal currents to displace the sand causes the inlet channels to shoal (Bruun, 1986; Bruun and Adams, 1988). Louisiana tidal inlets are not shoaled because of an overall dearth of coarse sediments within the inlet/barrier system.

Tidal prism through an inlet is not wholly controlled by bay area. The efficiency of tidal exchange between the bay and the ocean is a function of inlet cross-section within the barrier shoreline. The Mississippi delta plain suffers from a depleted source of longshore sediment. There is no sand size material available to heal barrier breaches caused by storm surges or extreme wave events. This has resulted in a high ratio of inlet-channel cross-section to tidal prism. In these areas the tidal prism is being distributed through many inlets or extremely large ones and tidal currents are minimal. Decreased tidal currents allow wave influenced inlet morphologies to form.

### OBJECTIVES

The first objective of this paper is to describe the five inlet types occurring along the transgressive Mississippi River delta shoreline. The second objective is to document the strong correlation between inlet morphology and the relative age of the barrier system in

which it is located. The relative age of the system is a function of bay size, barrier morphology, and inlet type. Finally, a model which explains the evolution of tidal inlets within abandoned delta lobes of the Mississippi River delta plain will be offered.

## STUDY AREA

### Geologic Setting

The coalescence of sixteen delta lobes deposited by the Mississippi River comprises the Holocene delta plain (Figure 2) (Frazier, 1967). The barrier shoreline observed along the delta plain contains remnants of these past delta lobe progradations (Figure 3) (Penland and Boyd, 1981). The most recently abandoned lobes (Late LaFourche and Plaquemines) exhibit erosional headlands with flanking spits and barrier islands. The next oldest lobes, the Early Lafourche and St. Bernard, are represented presently by the Isles Dernieres and Chandeleur Barrier Island Arc systems, respectively. The oldest abandoned lobe, the Maringouin is represented in part by the subaqueous Ship Shoal (Penland and Boyd, 1981; Nummedal et al., 1984).

### Barrier Formation in the Mississippi Delta Plain

Once abandoned, sediments eroded from the abandoned headland are built into flanking spits that separate interdistributary bays from the Gulf of Mexico (Kolb and Van Lopik, 1958). This represents Stage 1 of Penland and

Boyd's (1981) barrier island model (Figure 4). Stage 2 occurs when the headland detatches from the flanking spit creating a sound behind the new barrier island arc system. With the finite amount of sand contained in the system, constant marine reworking by waves and tides, combined with local relative sea level rise, results in continued areal loss to the barrier arc. With time the barrier sands become increasingly subaqueous trending more and more towards the last stage of Penland and Boyd's model, inner-shelf shoals.

#### Relative Sea Level Change in the Delta Plain

Once an active delta lobe is abandoned the loss of sediment to the interdistributary area results in landloss. The lack of renewed sediment allows relative sea level rise to inundate low points of elevation (Gagliano et al., 1981). Present rates of sea level rise along the delta plain were determined through radiocarbon dating of buried, in-situ peats and ranged from 0.3 to 0.6 cm/yr (Penland et al., 1987a). A subsidence rate of .75 cm/yr was calculated for the Pass Ronquille region by data collected for this dissertation. This value agrees with Conner and Day's (1986) calculations of 0.85 cm/yr for the Barataria region. Short term rates measured from tide gage data indicate a local relative rate of sea level rise approaching 1.2 cm/yr (Swanson and Thurlow, 1973; Ramsey and Moslow, 1987). These high rates of relative sea level abate with depth (Gerdes,

1982; Il, 1987). The high rates of landloss and relative sea level rise documented in the delta plain since the early 1800's have caused the bay areas behind the barrier shorelines to expand greatly. This bay expansion causes tidal inlets to evolve in parallel with barrier island development in the Mississippi River Delta Plain.

### TIDAL INLET MORPHOLOGY

The continuum of tidal inlets within the Mississippi River deltaic plain includes five generic types, young and old wave- dominated, young and old transitional, and one tide-dominated morpho-type (Figure 124). The two types of wave-dominated and transitional inlets are differentiated by slight but distinct differences in inlet sand body type. Designations and descriptions of each inlet type are as follows:

**Wave Dominated - young:** Shallow, ephemeral inlet throats in young wave-dominated inlets may be periodically closed by longshore sediment transport. Intertidal flood-tidal deltas are formed landward of the inlet throat by the combined transport power of waves and the incoming tides. The lobate, sandy accumulation may become supratidal and vegetated. Pass Ronquille is the type example of a young wave-dominated inlet (Figure 62).

**Transitional- young:** This inlet type occurs when ebb

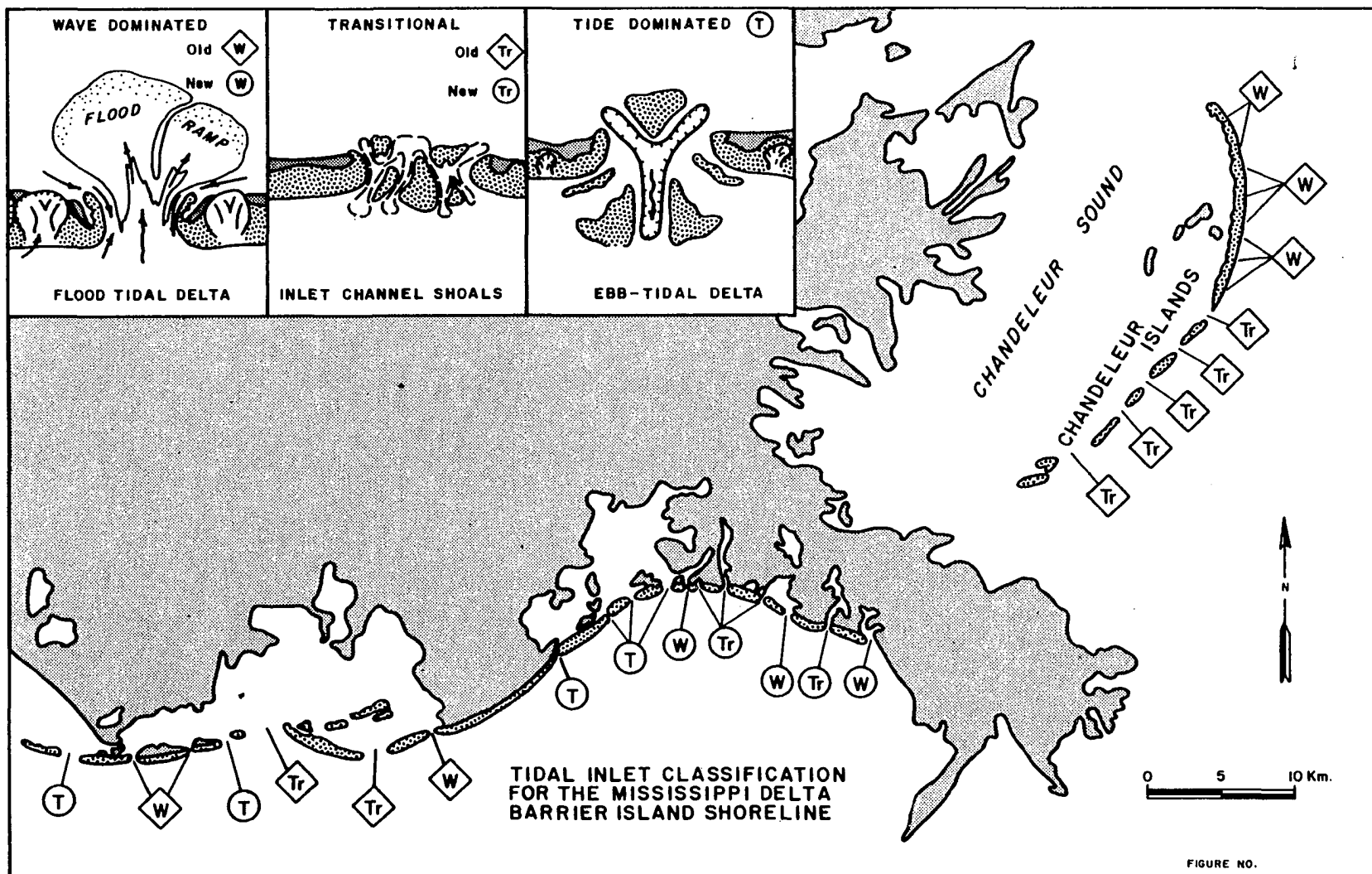


Figure 124. Tidal inlet variability and distribution along the Mississippi River delta barrier shoreline.

directed sediment transport is equal to the combined transport potential of flooding waves and tidal currents. Sandy shoals separated by variable depth channels form between adjacent barriers within the inlet throat. Slight seaward and landward bulges of inlet sand bodies may define rudimentary ebb and flood tidal deltas (Figure 124). Cat Bayou depicted in charts from 1886 exemplifies this inlet type (Figure 125).

**Tide-Dominated Inlets:** Where tidal prism through an inlet is large enough tidal energies dominate wave energies and features associated with tide-dominated inlets are exhibited; including, deep main ebb channels, well developed ebb and flood tidal deltas, and marginal flood channels. Barataria Pass (Figure 126) is the most impressive of these inlets with throat depths exceeding 20 meters and an ebb tidal delta that contains nearly as much sand as that contained in the bounding barrier islands (Shamban, 1985).

**Transitional- old:** Older transitional inlets reflect deteriorated remnants of tide-dominated inlets. The main ebb channel is less well defined due to infill by landward and longshore transported nearshore sediments. Similar to the younger transitional inlet, shoals are located within the inlet throat. In this inlet, however, these shoals can actually be pieces of the barrier terminus which once confined the pass channel. Little Pass Timbalier, as mapped



in 1956, exhibits characteristics of this inlet type (Figure 127).

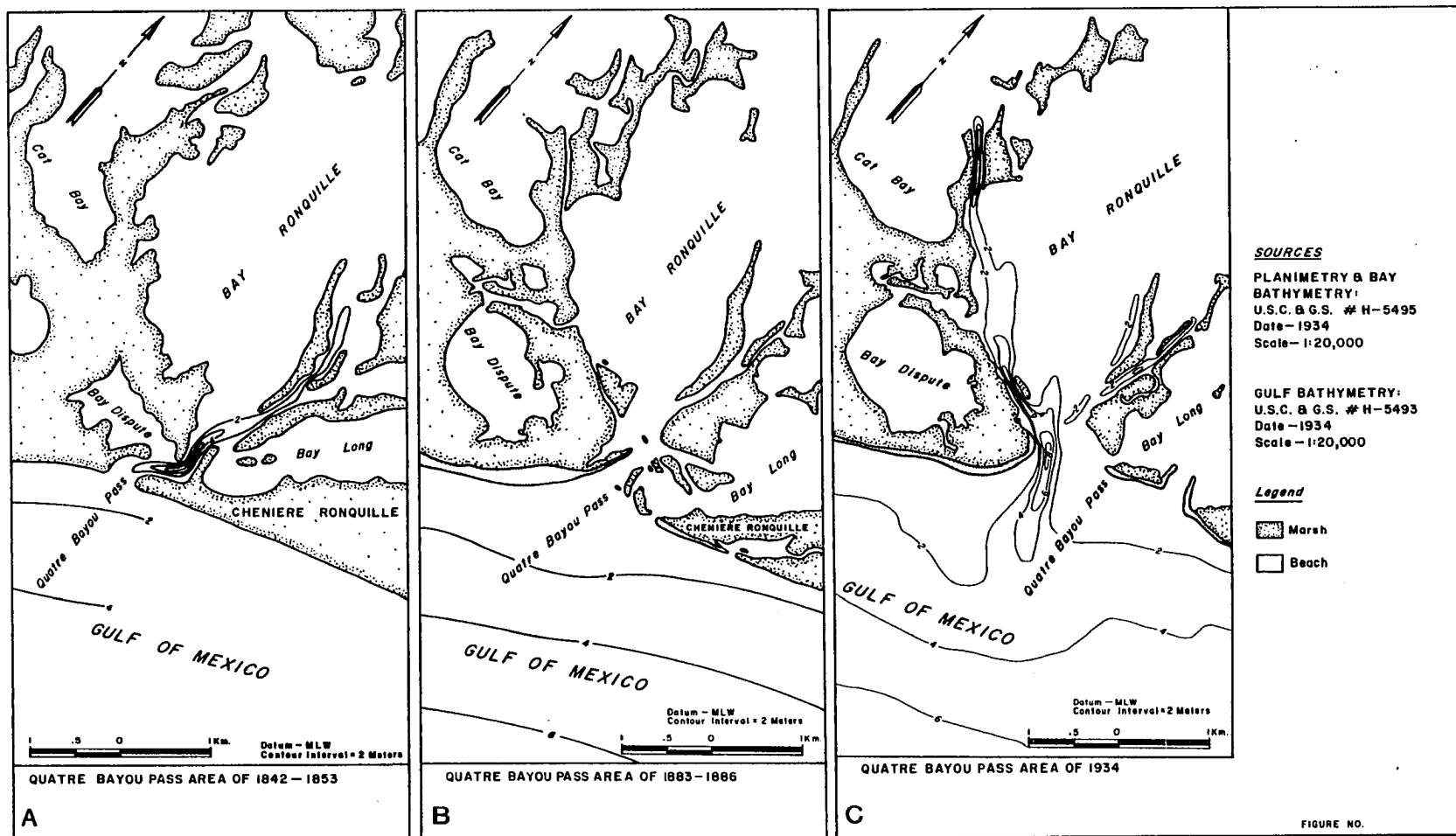
**Wave Dominated - old:** The older wave dominated inlet is similar in appearance to the younger type. The major difference is that at this stage the flood-tidal delta is subtidal (Figure 128). Inlets located in the South Chandeleur barrier island arc system are excellent examples of this inlet type.

#### **TIDAL INLET LOCATION**

##### **Inlets In Flanking Barrier Islands**

As the flanking spit of the Stage 1 barrier (Penland and Boyd, 1981) grows across the developing interdistributary bay (Figure 4) it increasingly constricts the tidal flow between the bay and Gulf. Initially, due to the limited tidal prism contained within the young, spit enclosed-bay, tidal currents are minimal and wave energies dominate inlet morphology. A sandy flood-tidal delta will gradually form on the landward side of the inlet throat. Associated ebb-tidal deltas are absent or have minimal expression.

Contemporaneously with the growth of the spit system the back bay area expands (Lindstedt, 1982) due to subsidence and wave induced erosion of the bay perimeter (Adams, et al. 1976; Gagliano et al., 1981). Lindstedt (1982) reported that Barataria Bay area exhibited an



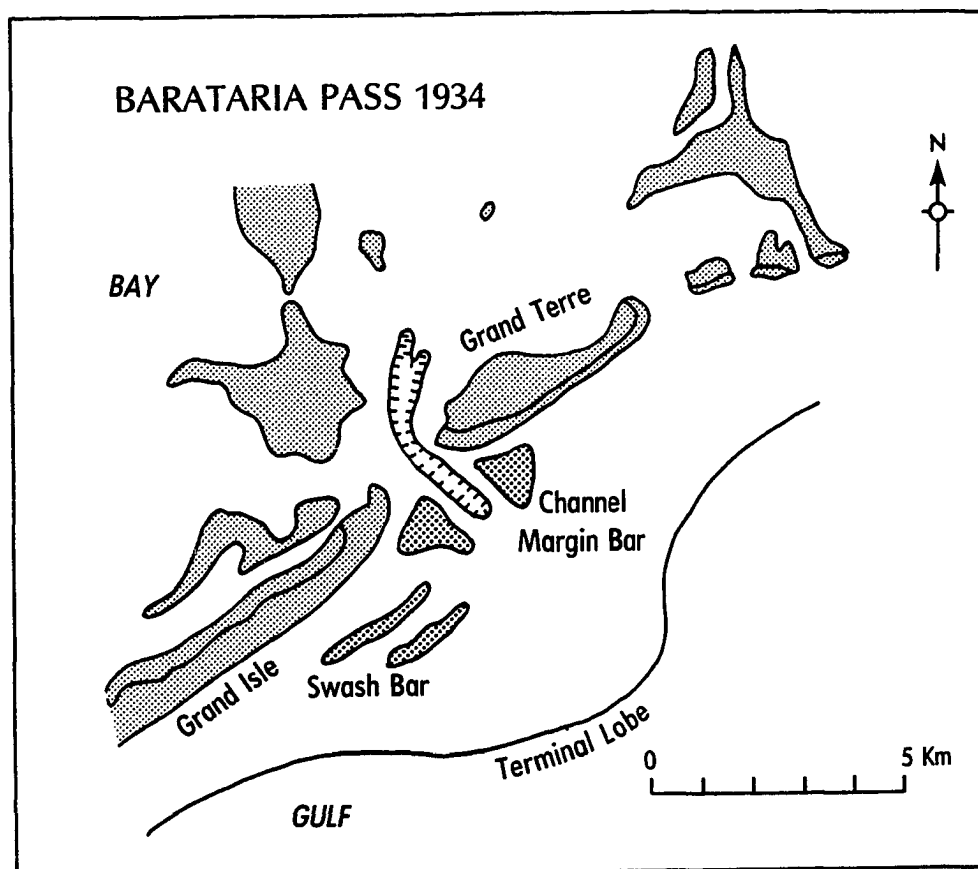


Figure 126. Diagram of Barataria Pass. Tide-dominated features include a well developed ebb-tidal delta, main-ebb-channel and marginal flood channels.

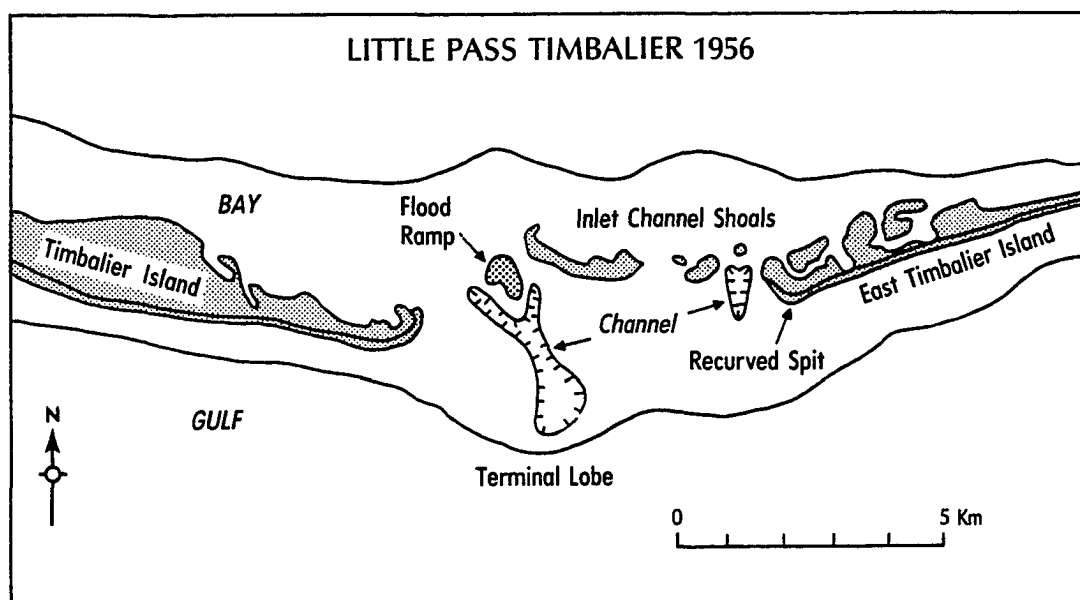


Figure 127. Little Pass Timbalier, 1956. This is an older transitional tidal inlet. The main ebb channel is filling and the terminal lobe of the ebb-delta is being pushed landward. Inlet channel shoals are actually remnants of old recurve spits that once confined the inlet channel.

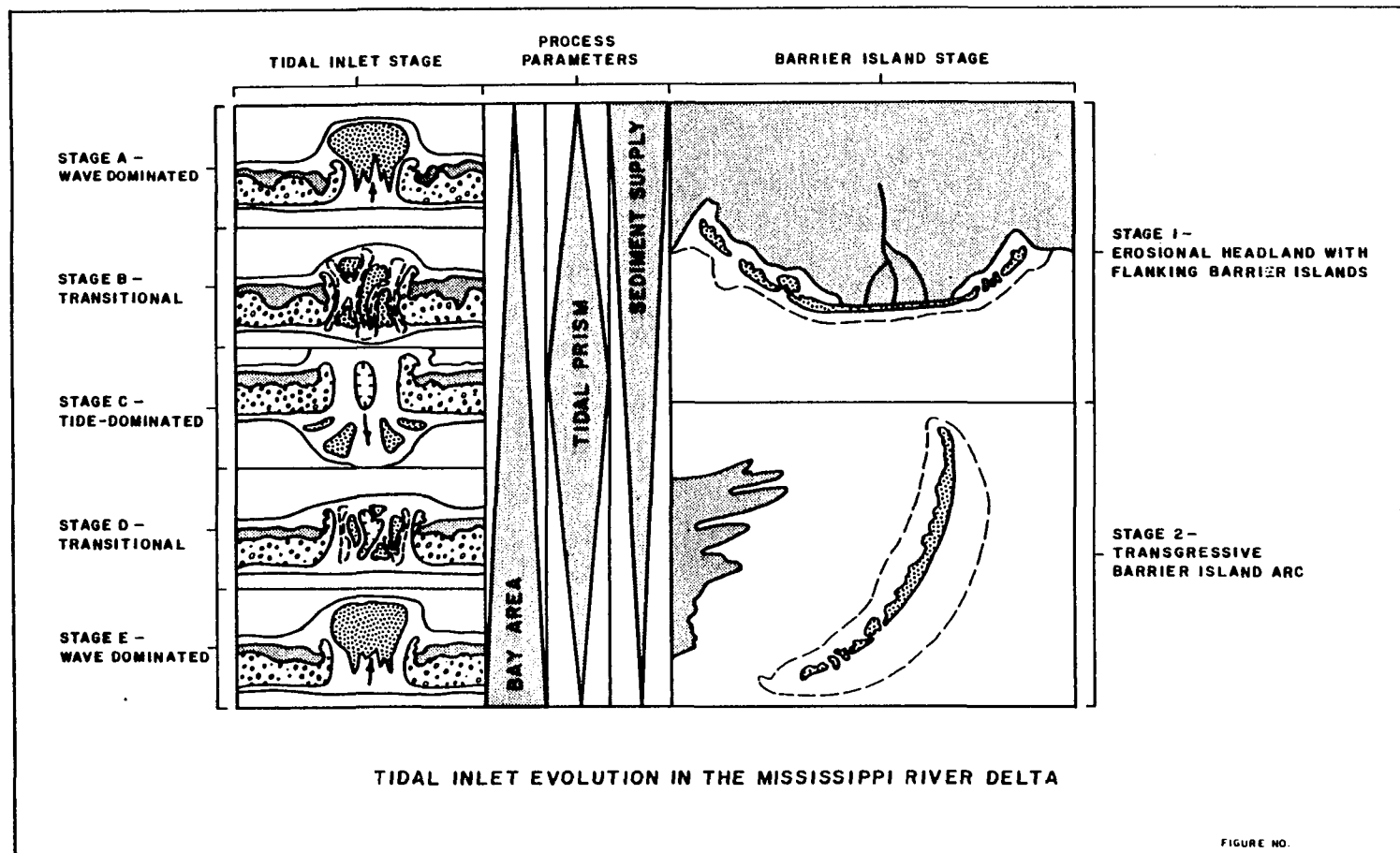


Figure 128. Summary diagram of tidal inlet evolution in a deteriorating delta lobe. As bay area increases tidal prism through the inlet increases and inlets evolve from wave to tide-dominated. When the sediment supply becomes limiting, unhealed breaches through the barrier results in decreased through-the-inlet tidal prism. The inlet evolves from a tide to wave-dominated morphology.

increase of over 50% in open saline and brackish water environments between 1891 and 1978. Independent studies conducted by Lindstedt (1982) and Britsch and May (1987) indicated increases in the Barataria Bay area of just under 25 %, or approximately 250 square kilometers, respectively, between 1930 and 1978 (Table 5). The net tidal prism affecting the tidal inlets is, admittedly, less than the volume determined simply by finding the product of the bay and the mean tidal range. Regardless of the absolute increase in tidal prism to the inlet, the expanding bay area will cause a corresponding amplification of tidal currents. Increased tidal power causes an increase in sediment transport effectiveness through the inlet (Figure 128). As a result shoals are likely to be formed within the inlet throat (Hubbard et al., 1979) forming young transitional tidal inlets. This inlet morpho-type exhibits compact flood tidal deltas and some seaward expression of an ebb tidal delta. Tide-dominated inlets occur where flanking spits have built across large interdistributary bays or an initially small back bay area has expanded greatly. In lieu of a large tidal range the increased bay area forces a larger tidal prism to be exchanged between the bay and the Gulf. Tidal currents intensify and tide-dominated inlet morphologies evolve. The best examples of tide-dominated inlets occurring along the Mississippi River Delta Plain are found at the entrances to Barataria

Bay and Bay Ronquille (Figure 129).

### **Inlets Along The Barataria Barrier Shoreline**

The eastern Barataria Bight shoreline consists of a series of headlands that were connected by Grand Terre Barrier prior to 1841 (Figure 129). Presently, the low-profile barrier is part of an overall transgressive shoreline which is flanked and breached by four tidal inlets. From west to east they are Barataria Pass, Pass Abel, Quatre Bayou Pass, and Pass Ronquille. All but Pass Ronquille are tide dominated inlets. The combined width of the open water within the passes is nearly equal to the subaerial remnants of the adjacent barrier shoreline.

### **Tidal Inlet Evolution, Barataria Bight**

Barataria Pass formed when the Grande Isle spit built across the front of Caminada and Barataria Bay forming a constricted passage against the westward end of Grande Terre Island (Gerdes, 1985). Historical accounts (Cowden, 1877) and charts dating back to the early 1800s show no evidence that Barataria Pass has recently been other than a tide-dominated inlet (Figure 129) (Shamban, 1985). However, the inlets east of Barataria Pass have only recently (last 100 yrs) been breached and modified to accommodate the continually increasing tidal volume exchanged between the Gulf and Barataria Bay (Figure 129). Charts dated 1841 indicate that Quatre Bayou Pass was then wave dominated and

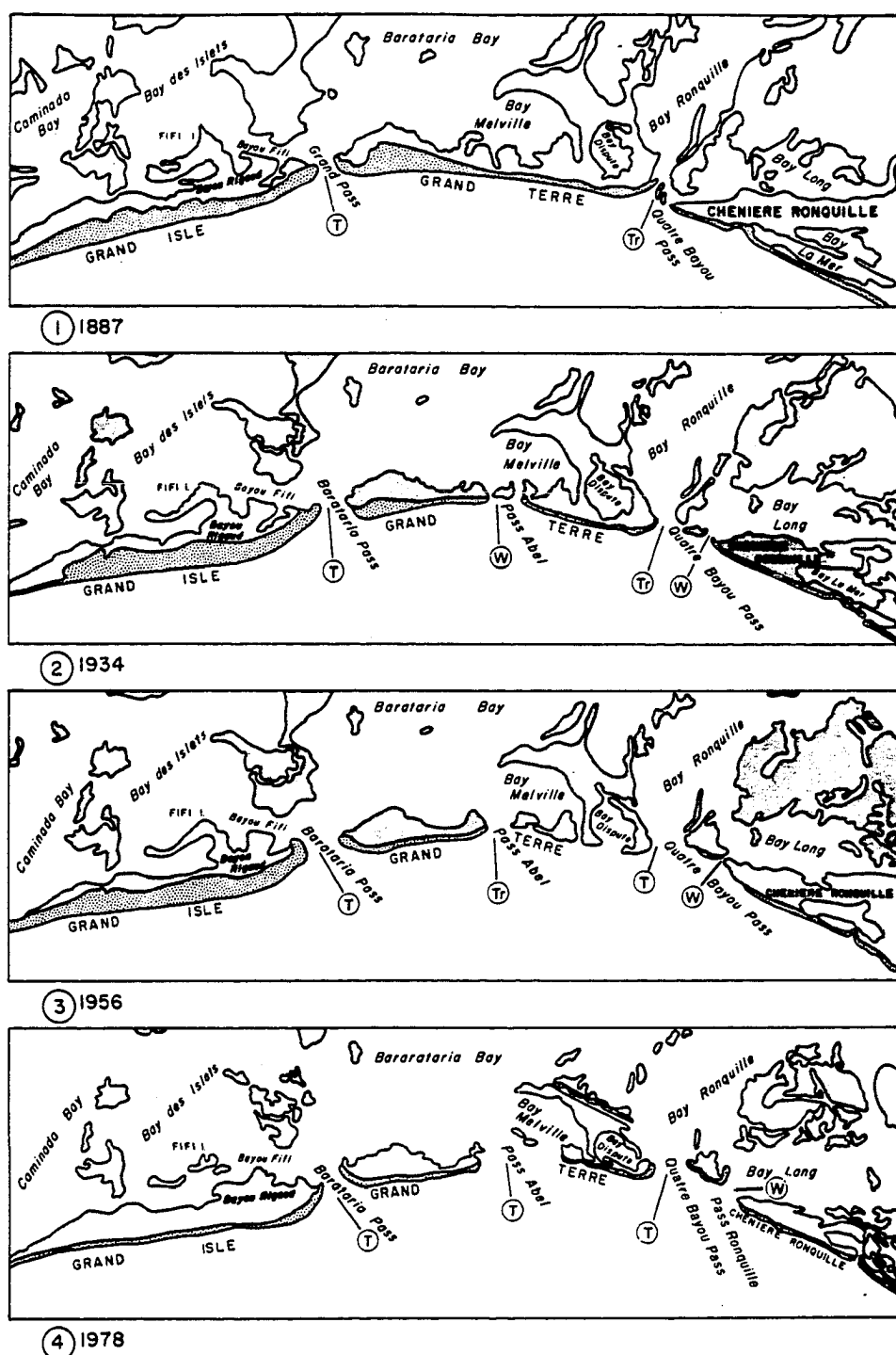


Figure 129. Inlet evolution in Eastern Barataria shoreline between 1887 and 1978. Barataria Pass has been a tide-dominated inlet since 1887. Pass Abel became permanently established around 1934. Quatre Bayou Pass has evolved from a small transitional inlet-type to a tide-dominated between 1841 and 1956. Pass Ronquille did not form until 1934.



had by 1886 evolved to a transitional configuration as a result of increased tidal flow. A reliable chart produced in 1841 depicts Pass Abel as a breach in the island. Later maps do not show Pass Abel suggesting its past ephemeral occurrence. Pass Ronquille, the eastern-most occurring inlet in the Barataria shoreline, did not open until the 1930's and was then wave dominated. According to available historical maps Quatre Bayou Pass and Pass Abel had developed tide-dominated morphologies by 1952 and 1978, respectively, while Pass Ronquille remained wave dominated through 1982. Recent breakup of the marsh on the northern margin of Bay Long has caused the capture of Bay Ronquille waters by Bay Long and an increase in tidal prism through Pass Ronquille. As a consequence, since 1982, Pass Ronquille has begun evolving into a young transitional inlet. The sands comprising the inlet's classic flood-tidal delta are beginning to move seaward, choking the inlet channel throat.

#### **Inlet Deterioration In A Flanking Barrier Shoreline**

Where there is an adequate longshore sediment supply replenishing the spits in stage 1 barriers, then inlet evolution is due primarily to changes in tidal prism through bay area enlargement. According to FitzGerald and Nummedal (1983) there would not be a substantial lag time between bay enlargement and the corresponding increase in tidal inlet cross-sectional area.

Inlet widths essentially doubled at Barataria Pass (Shamban 1985) and Quatre Bayou Pass and increased five-fold at Pass Abel between 1932 and 1971 (Table 6). The Quatre Bayou channel cross-sectional area has increased by a factor of 3.4 from 550 m<sup>2</sup> to 1890 m<sup>2</sup> between 1841 and 1934 (Table 7). The channel cross-section measured again in 1982 had not increased significantly since 1934, despite continued bay enlargement. Inlet cross-sections at Barataria Pass increased by a factor of 1.6 between 1878 and 1934. However, no appreciable increase in channel cross-section has occurred in Barataria Pass since that time (Shamban, 1985) while both Quatre Bayou Pass and Pass Abel continued to expand. It appears that the combined pass cross sections within the eastern Barataria shoreline increased concurrently with Barataria Bay enlargement to allow efficient transmission of the tidal wave between the bay and gulf.

When longshore sediment supply is not limiting, the relationship between inlet cross-section and tidal prism is straight forward. With increases or decreases in tidal prism the inlet cross-section increases or decreases accordingly. When sediment supplied to the channel margin becomes limiting, the inlet cross-section will expand due to erosion of the flanking barrier regardless of the tidal prism. In the Barataria inlet system inlet widening is the result of lacking longshore sediment supply. Recent shoreline surveys

demonstrated that wave induced erosion caused Quatre Bayou Pass to widen by 15 meters between February and May of

Table 5: Barataria Bay Increase (km<sup>2</sup>)

| Year                     | 1892 | 1932 | 1960 | 1978 |
|--------------------------|------|------|------|------|
| Bay Area km <sup>2</sup> | 955  | 1209 | 1292 | 1491 |

(From Lindstedt, 1982)

Table 6: Temporal Change in Barataria Shoreline Pass Width

| Pass Width     | 1841 | 1932 | 1956 | 1971 | 1982 | 1983 |
|----------------|------|------|------|------|------|------|
| Barataria Pass | ---  | 654  | 702  | 1042 | ---  | 647* |
| Pass Abel      | ---  | 129  | 304  | 751  | 2200 | ---  |
| Quatre Bayou   | 220  | 650  | ---  | 1050 | 1200 | ---  |

\* Width decreased by artificial means

Table 7: Inlet Throat Increase in Barataria Shoreline

| Pass              | Year | 1841 | 1878 | 1934 | 1982 | 1984 |
|-------------------|------|------|------|------|------|------|
| Barataria Pass    | ---- | 4240 | 6840 | ---  | 6290 |      |
| Pass Abel         | ---- | 300  | 900  | ---  | 1900 |      |
| Quatre Bayou Pass | 550  | ---  | 1140 | 1775 | ---  |      |

1983. Pass widths continue to increase due to wave erosion. When the inlet cross-section increases faster than the relative increase in tidal prism (by bay enlargement) tidal currents through the inlet decrease. The diminishing tidal current allows the reestablishment of wave influenced morphology and causes the evolution of tide-dominated inlets to older transitional types. A 1956 bathymetric map of Little Pass Timbalier (Figure 127) shows relict features of an inlet that was once tide-dominated. A

loss of sediment supply from adjacent, eroded barriers and the parent headland has resulted in a significant widening of the inlet opening. Resultant losses of tidal current energies flowing through the inlet has allowed the reestablishment of wave influenced sand bodies. Similar inlet expansion was documented historically in Cat Island Pass, Louisiana by Suter and Penland (1987). Some shoals in these older transitional inlets are actually fragmented pieces of the deteriorating, bounding barrier. Further, it appears that wave transport processes cause the terminal lobe of the ebb delta to flatten landward and the main ebb channel to fill with longshore and landward transported sands. The processes responsible for morphologic change of Little Pass Timbalier and Cat Island Pass (Suter and Penland, 1987) are expected to effect the inlets within the eastern Barataria shoreline and other Mississippi River delta plain inlets located within flanking barrier systems which have limited sediment supplies.

#### **Inlets Within Barrier Island Arcs**

The tidal inlets that incise Stage 2, barrier island arc systems (Penland and Boyd, 1981) are primarily deteriorating tide-dominated, older transitional and wave-dominated types. In Stage 2 the barrier inlets evolve from tide-dominated to wave-dominated with an intermediate transitional type as the barrier island arc deteriorates (Figure 128).

The Chandeleur Barrier Island Arc system represents the final subaerial remnant of the St. Bernard Delta lobe (Figure 3) and separates the Chandeleur Sound from the Gulf of Mexico. It is also separated from the mainland at each flank by nearly 20 km of open water. The barriers are incised by numerous inlets that combine with the open flanks of the arc system to form a non-restrictive passage for the tides (Hart, 1975). As a result of the large total inlet cross-sectional area, the tidal currents in each inlet are generally very weak. Inlets that were tide-dominated toward the end of the stage 1 and beginning of stage 2 of Penland and Boyd's (1981) barrier island model (Figure 4) have evolved into older transitional inlets (Figure 128). At this stage the barrier is extremely fragile. Inlet widening continues on a daily basis and new breaches formed during minor storms do not close (Kahn, 1985). Sand left in the system that is transported bayward is added to a subaqueous flood-tidal delta (Figure 130). In this final stage of inlet evolution the subtidal flood tidal delta is contrasted with the intertidal flood-delta of the youngest inlet type.

#### CONCLUSIONS

Five inlet morpho-types occur along the shoreline of the Mississippi River Delta Plain. They are 1) young wave-dominated with intertidal flood tidal deltas, 2) young transitional with shoals choking the inlet throat, 3) tide-dominated inlets exhibiting deep channels and large ebb

tidal deltas, 4) older transitional inlets with ebb tidal deltas flattened landward at the terminal lobe, infilling tidal channels and spits detached from the adjacent barriers, and 5) older wave-dominated inlets with subtidal flood tidal deltas.

Tidal inlet morphology along this coast is correlated to the relative age of the delta lobe system in which it is contained (Table 8). In stage 1 of the barrier island model (Penland and Boyd, 1981) an associated temporal increase in bay area (and tidal prism) following delta lobe abandonment causes tidal inlets to evolve from wave dominated to tide dominated morphologies with a transitional stage in between (Figure 128). In Stage 1, flanking barrier systems, sediment supplied to adjacent, channel confining spits is not limiting.

By limiting sediment supply barriers fragment and tidal inlets widen faster than relative increases in tidal prism produced by bay expansion. Tidal currents decrease and inlets of late stage 1, flanking barrier islands, and early stage 2, barrier island arc systems, that were once tide-dominated develop wave influenced morphologies evolving to old transitional and finally to old wave-dominated inlets.

Along the Mississippi River Delta Plain tidal inlets

| BARRIER<br>SHORELINE             | RELATED<br>DELTA LOBE          | STAGE OF<br>ABANDONMENT      | SEDIMENT<br>SUPPLY | TIDAL<br>PRISM | INLET<br>TYPE                               |
|----------------------------------|--------------------------------|------------------------------|--------------------|----------------|---------------------------------------------|
| Shell Island                     | Modern/<br>Plaquemines         | Recent                       | Available          | Limited        | Young Wave-Dominated                        |
| East Barataria                   | Plaquemines                    | Flanking<br>Barrier          | Available          | Limited        | Young Wave-Dominated*<br>Young Transitional |
| East Timbalier                   | Late Lafourche                 | Flanking<br>Barrier          | Available          | Limited        | Young Wave-Dominated                        |
| Grand Isle                       | Late Lafourche                 | Flanking<br>Barrier          | Available          | Large          | Tide-Dominated                              |
| Grand Terre                      | Plaquemines/<br>Late Lafourche | Flanking<br>Barrier          | Restricted         | Large          | Tide-Dominated **                           |
| Timbalier                        | Late Lafourche                 | Flanking<br>Barrier          | Restricted         | Large          | Old Transitional                            |
| West and East<br>Isles Dernieres | Early Lafourche<br>(?)         | Barrier Island<br>Arc System | Available          | Large          | Tide-Dominated                              |
| Central<br>Isles Dernieres       | Early Lafourche<br>(?)         | Barrier Island<br>Arc System | Restricted         | Limited ***    | Old Wave-Dominated                          |
| Northern<br>Chandealeurs         | St. Barnard                    | Barrier Island<br>Arc System | Available          | Limited ***    | Old Wave-Dominated                          |
| Southern<br>Chandealeurs         | St. Barnard                    | Barrier Island<br>Arc System | Restricted         |                |                                             |

\* = Pre 1982, presently evolving to young transitional inlet

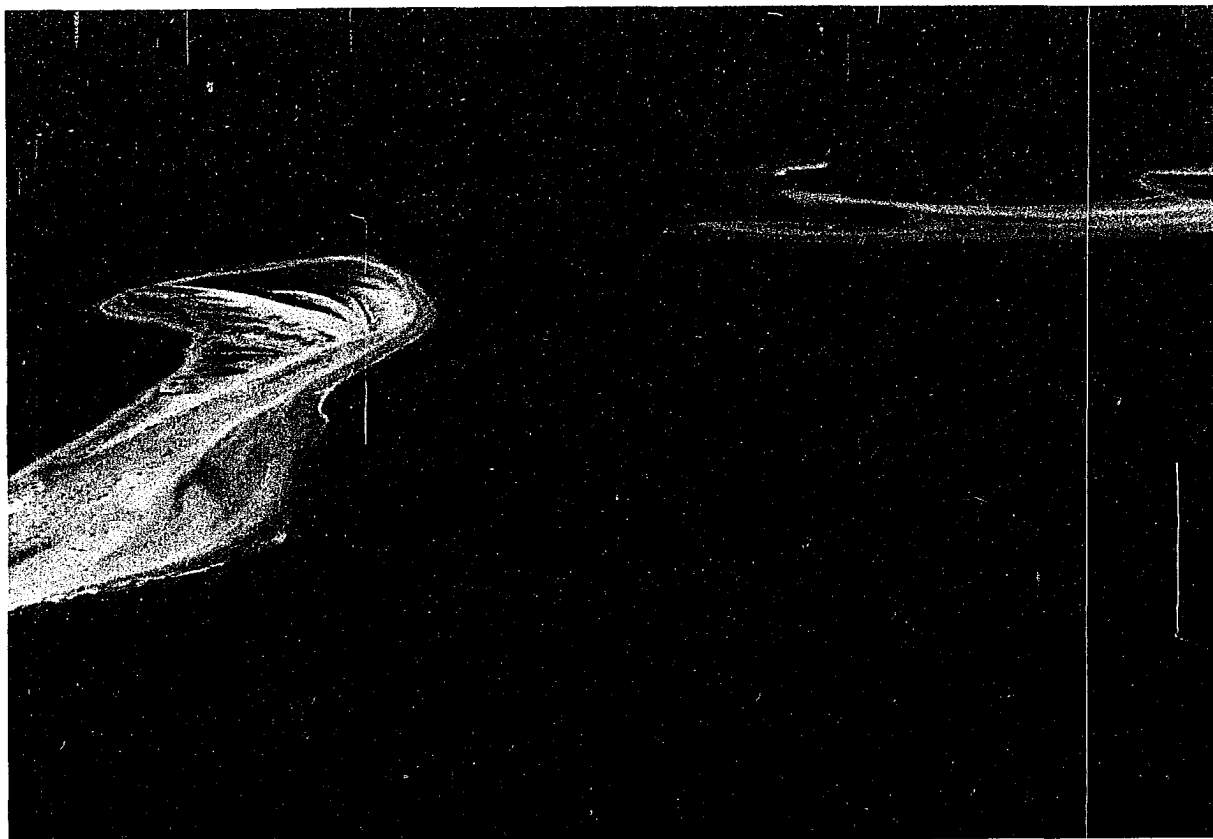
\*\* = Sediment supply is now restricted causing tide dominated inlets  
in this area to evolve to old transitional types.

\*\*\* = Despite the large tidal prism offered by the bay, the numerous  
tidal inlets within the local shoreline distribute it so  
that tidal currents through the individual openings are minimal.

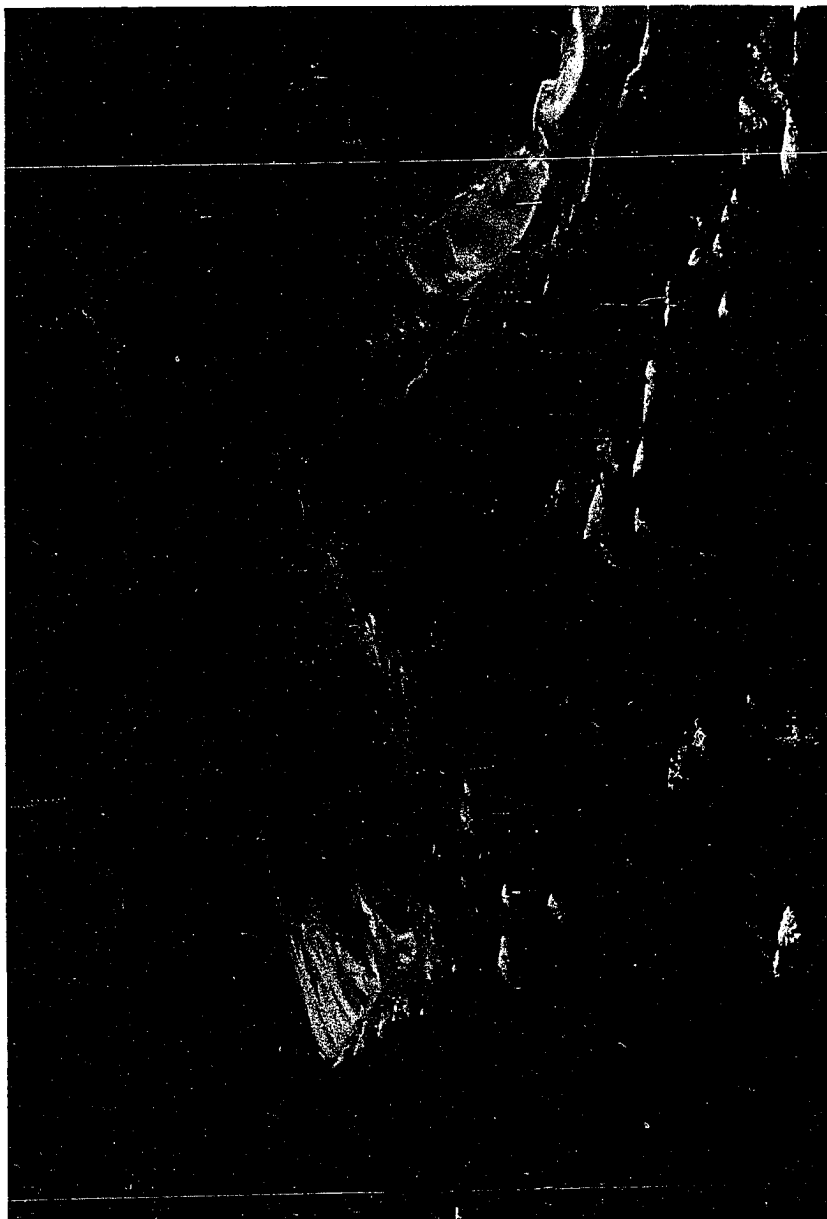
Table 8. Parameters associated with inlet type in abandoned delta lobes.

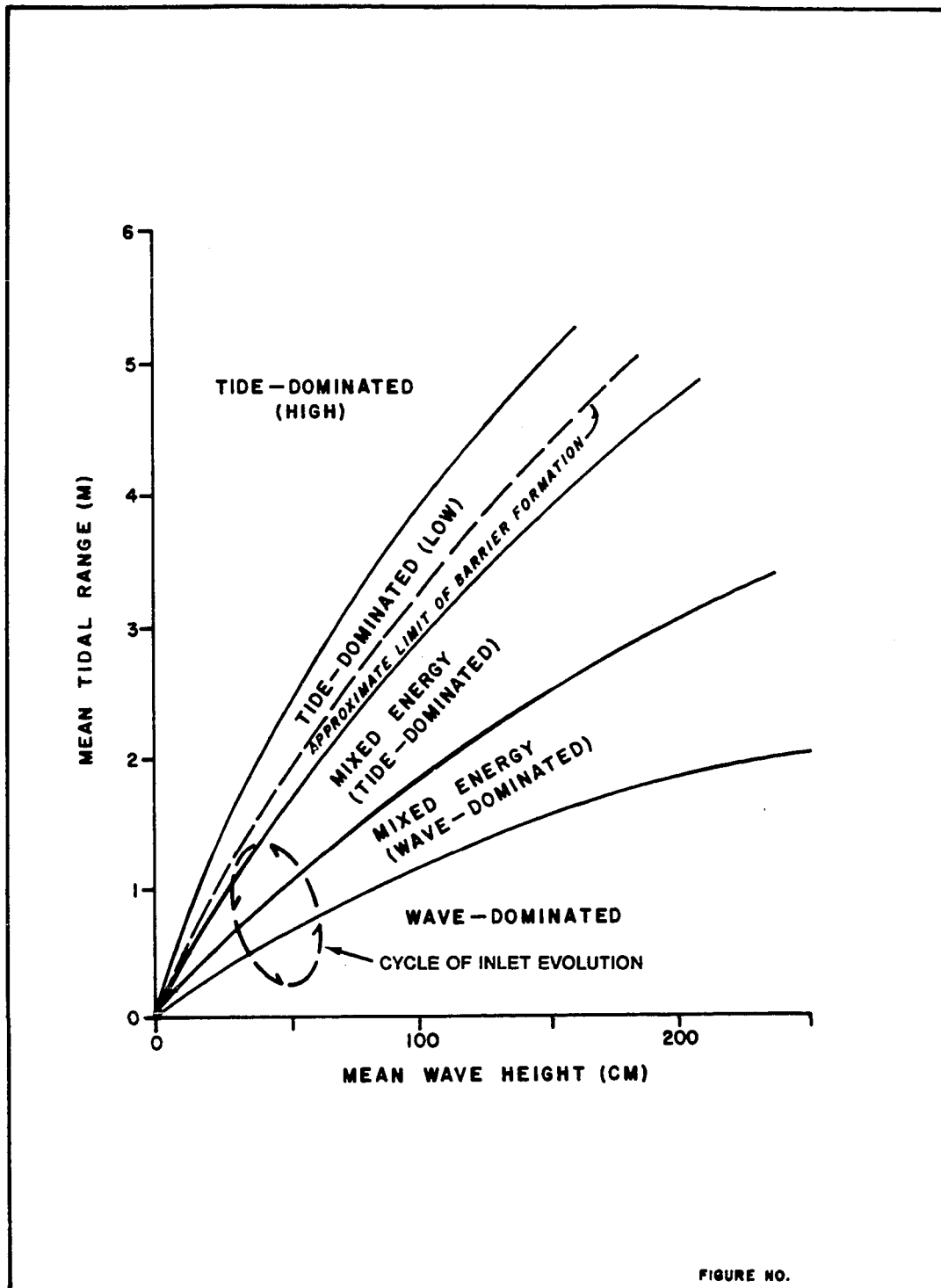
evolve from wave to tide dominated and back during the transgressive phase of delta lobe abandonment. This evolution is summarized using Hayes and Nummedal's (1979) plot of inlet type vs. tidal range and wave height (Figure 131). The temporal change in inlet morphology is concurrent with tidal prism increase due to back bay enlargement. As tidal prism through the inlet increases wave influenced inlet sand bodies are less prevalent. During later stages when tidal currents decrease, waves again become dominant within the inlet. That this evolution takes place while holding average wave heights and tidal range constant demonstrates the influence that tidal prism has on local inlet morphology.





130. Oblique aerial photographs of older transitional and wave dominated inlets of the Chandeleur Barrier Island arc system. A. The main ebb channel is being filled by sediments derived from longshore and ebb-delta sources. B.(on the following page) an older wave-dominated delta with a sub-tidal flood delta.





131. Circuit of tidal inlet evolution superimposed upon Nummedal and Hayes (1978) plot of inlet morphology as a function of tidal height and wave height.

## **11. THE MODERN TRANSGRESSION OF THE BARATARIA COASTAL SYSTEM**

### **INTRODUCTION**

Tidal inlets along the Mississippi River delta plain are located where flanking barrier islands spread coastwise across the front of large interdistributary bays from abandoned deltaic headlands (Penland and Boyd, 1981) and at overwash breaches in low profile barrier islands (Kahn, 1985). Louisiana tidal inlets have also been suspected of occupying old distributary channels (Russell, 1939; Fisk, 1944; Price and Parker, 1979). This hypothesis is based on the observation that they do not appear to migrate a significant distance alongshore (Shamban, 1985; Suter and Penland, 1987).

### **Objectives**

The objectives of this chapter are: 1) to show that combinations of these three inlet types occur within the eastern Barataria shoreline 2) to correlate the lack of lateral inlet migration with their location within relict distributary channels and 3) illustrate the significance of barrier erosion in the vicinity of tidal inlets. Tidal inlet processes along this shoreline are controlled by changes in tidal prism. Tidal prism changes rapidly in Louisiana in response to landloss, subsidence, and changes in longshore sediment supply.

## Pass Abel

### Geomorphology

Pass Abel is a tide-dominated inlet located between Grand Terre Barrier Island and Barataria Headland (Figure 132). Its main ebb channel (Hayes, 1975) occupies the west edge of Bay Melville. Outside the main channel average depths in Bay Melville are about 1 meter. A large flood-tidal delta dominates the shallow portion of Bay Melville. The channel is approximately 250 m wide, has a maximum depth of eight meters and comprises only 12 per cent of the total pass width (Figure 132). A shallow pass platform of Bay Melville dominates the inlet throat cross section. The entire pass opening has a cross-sectional area of  $3500 \text{ m}^2$ .  $1350 \text{ m}^2$  or 38 per cent is contained in the deep channel area. A subtly expressed ebb tidal delta merges laterally with shoals constructed by inlets to the east and west.

### Stratigraphy

A series of cores were taken directly through the banks of Pass Abel's main channel (Figure 81). Although core penetration did not reach the full thalweg depth, precise lithofacies can be assigned to greater than eighty percent of its boundaries. From eight to five meters (MSL) the channel banks consist of a coarsening upward overbank facies (Figure 81). Overbank sequences correlated to the Bayou Blue progradation decrease in thickness away from the

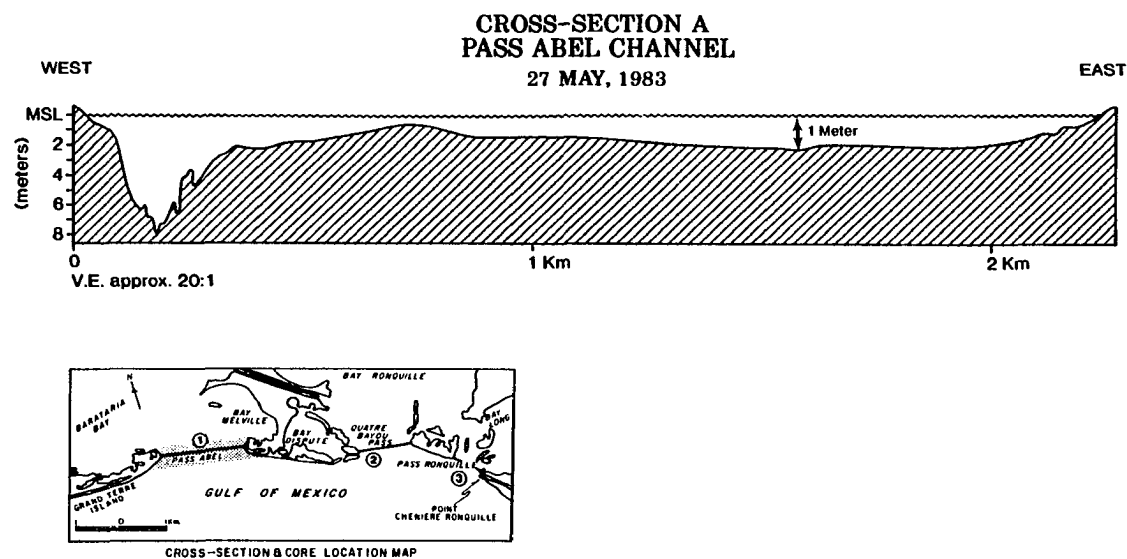


Figure 132. Pass Abel bathymetric profile. The deep narrow channel contains 12 per cent of the pass width, but nearly forty percent of the channel cross-sectional area.

location of the present channel. This progradation was part of the Bayou Blue delta lobe system. The Bayou Blue ravinement surface cuts across the Pass Abel region at approximately -4.0 m (Figure 84).

The Mississippi Delta Lobe built seaward in this area over the transgressive surface. Crevasse and coarse proximal overbank deposits lying on either side of the Pass Abel channel, at a depth of -1 to -2 m, suggest that an older channel has been reoccupied by the new one (Figure 81). The total stratigraphic package suggests that the modern Pass Abel channel has been the site of earlier distributary channels during both the Bayou Blue and Mississippi Lobe progradations.

#### Pass Abel - Map History

1817: This map shows a breach in Grand Terre at the approximate location of Pass Abel (Figure 133). The opening is small and a large, lobate intertidal shoal is located in its bay. A bathymetric contour of unknown depth seaward of the breach parallels the shoreline without indication that an ebb tidal delta is present. Pass Abel was probably wave-dominated at this time.

1841: A particularly detailed map produced by Barnard in 1841 depicts Pass Abel as "Cut Off" (Figure 134). Recurve spits confine a channel. Water depths in this channel are not readable on this map. Bathymetric contours show that a

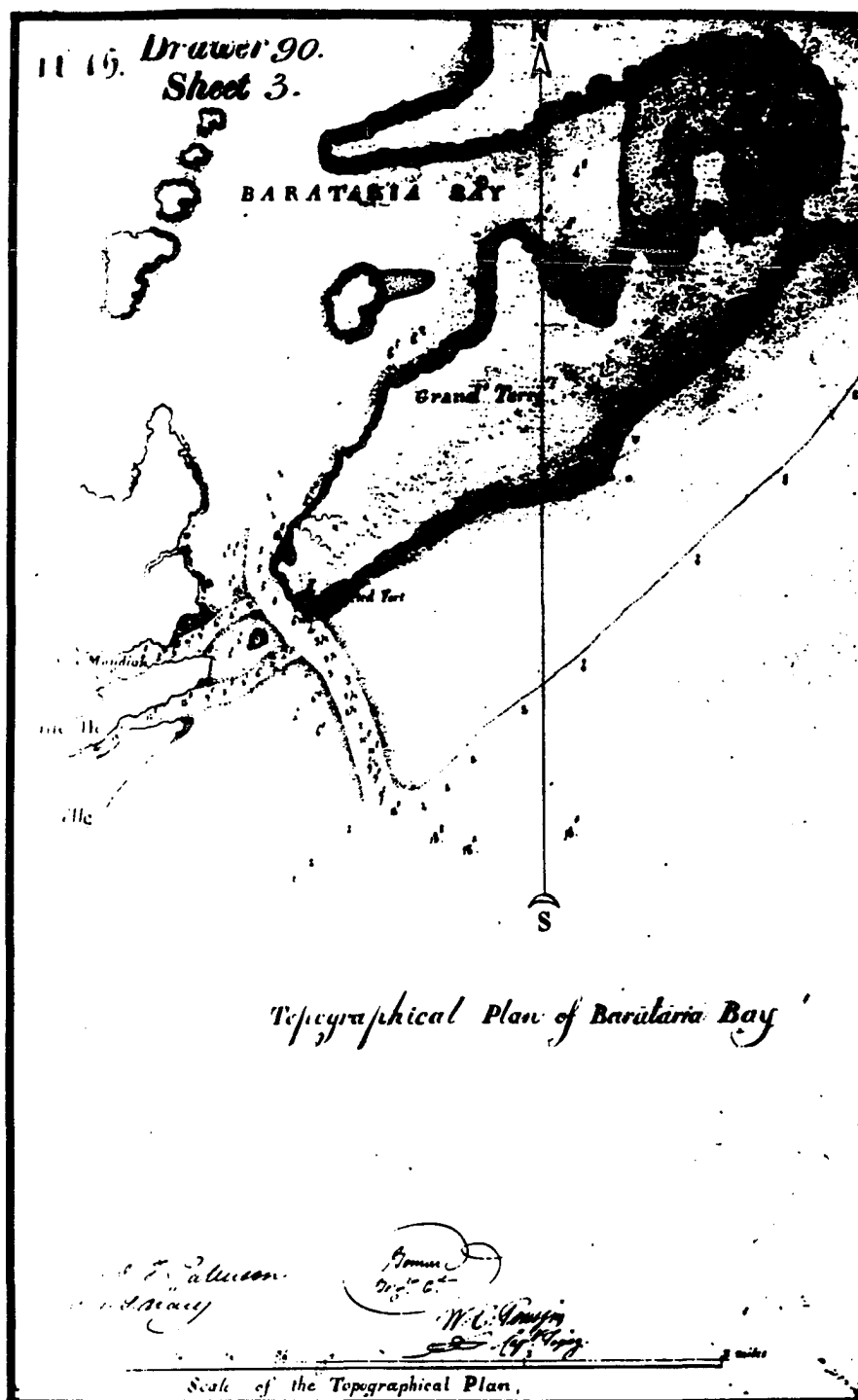


Figure 133. Pass Abel, 1817. The eastern side of Grand Terre is breached in the general vicinity of Pass Abel. An intertidal shoal is depicted on the landward side of the pass opening.



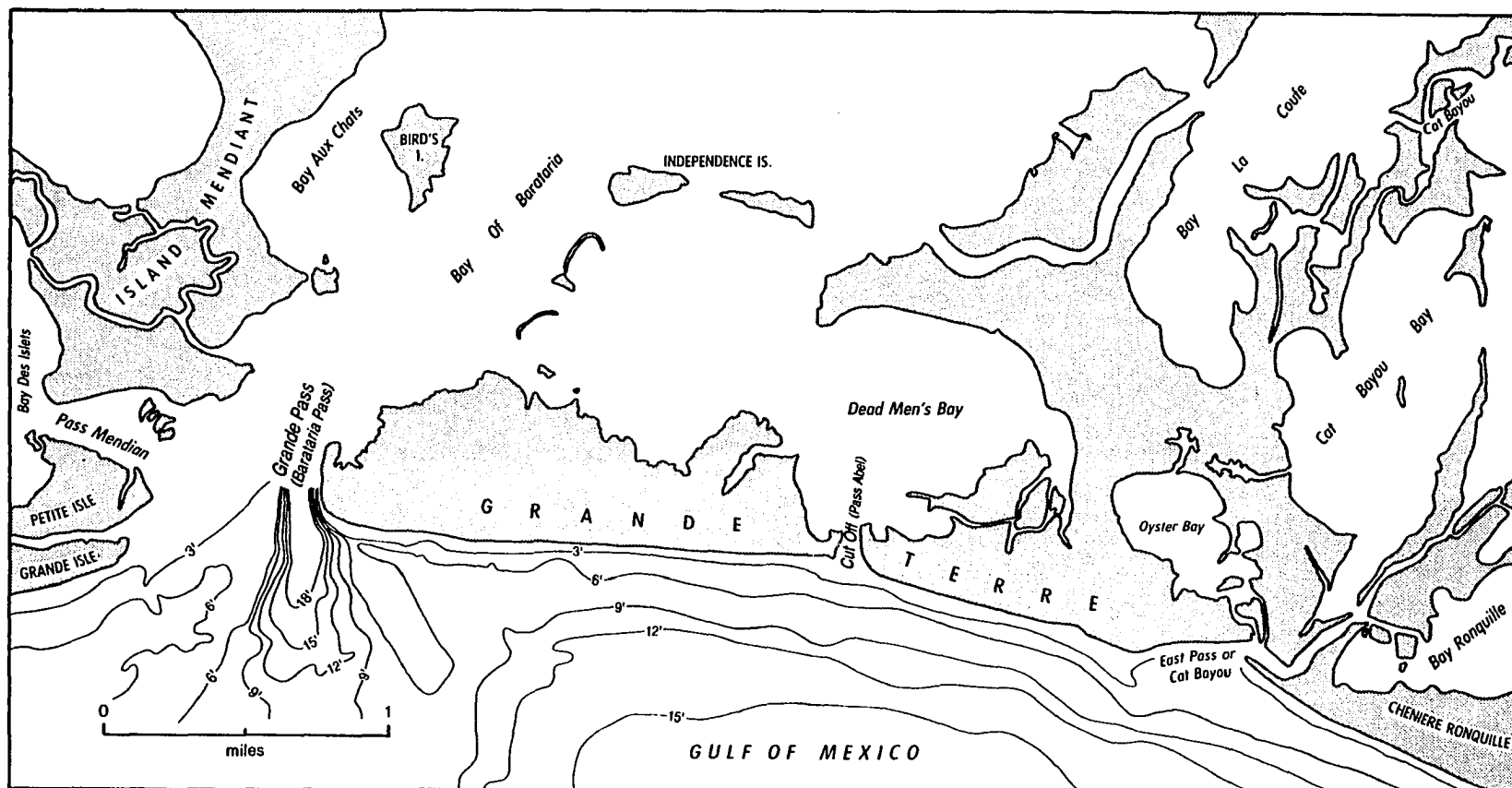


Figure 134. Grande Terre Barrier, 1841. Pass Abel is designated as "Cut Off" in this early shoreline map of Grande Terre.

small ebb tidal delta was present just seaward of the inlet throat. Aside from this breach Grand Terre is continuous from Barataria Pass to Cat Bayou.

1887: A large scale map of the Mississippi River alluvial valley produced by Leach and Turtle (1887) does not show Pass Abel (Figure 115). Detail shown within this map suggests that the Pass would have been illustrated if it had been open. It is apparent that longshore sediment transport periodically blocked the pass.

1937: NOAA chart no. 11358 published in September of 1984 (formerly CG&S 1273), utilizes unretouched 1937 hydrographic and topographic data. Shown in large scale is the drumstick-shaped barrier Grand Terre and a new breach on its thinning eastern end. Arcuate lobes of a flood tidal delta are stippled across the entire pass opening. Two small 1.5 meter deep channels cut through the flood delta, deepen abruptly to four meters and then shallow against the landward apron of the ebb tidal delta (Figure 135).

1973: A topographic map with limited bathymetric information was published in 1973. The eastern end of Grand Terre has two breaches separated by a fragment of the old island (Figure 136). Bathymetry published with the map had been adapted from earlier (1937) NOS charts and did not accurately depict the pass at this point in time.

1983: The subaerial fragment formerly separating the two pass openings has disappeared forming one continual breach

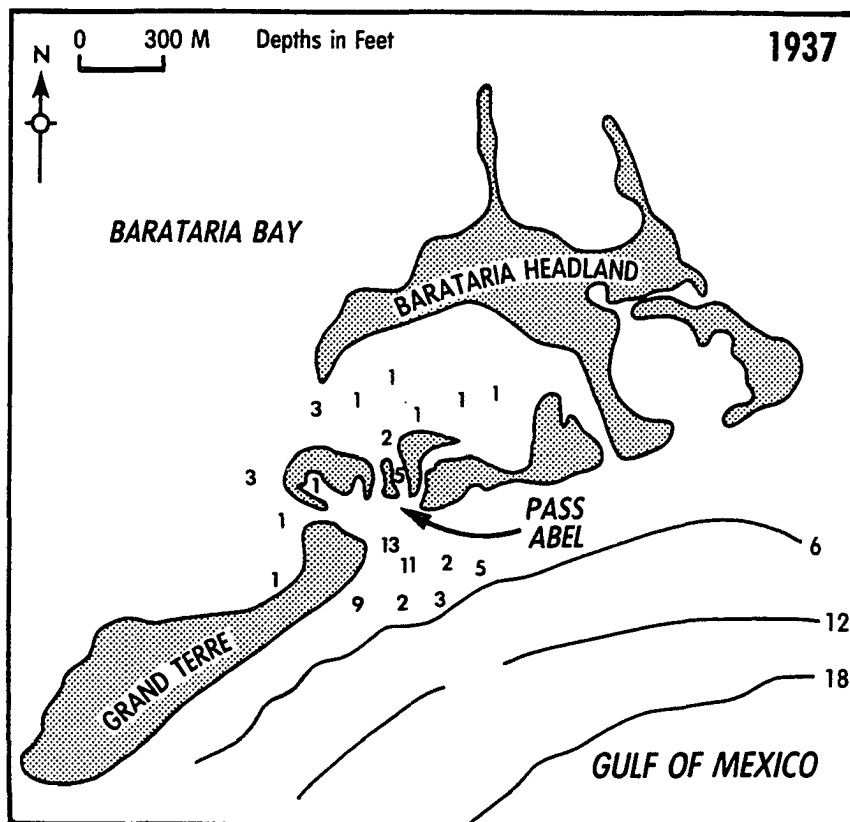


Figure 135. Pass Abel, 1937. Two small channels incise the flood-tidal delta. These channels deepen to 4 meters at the inlet throat before shallowing against the ebb-tidal delta.

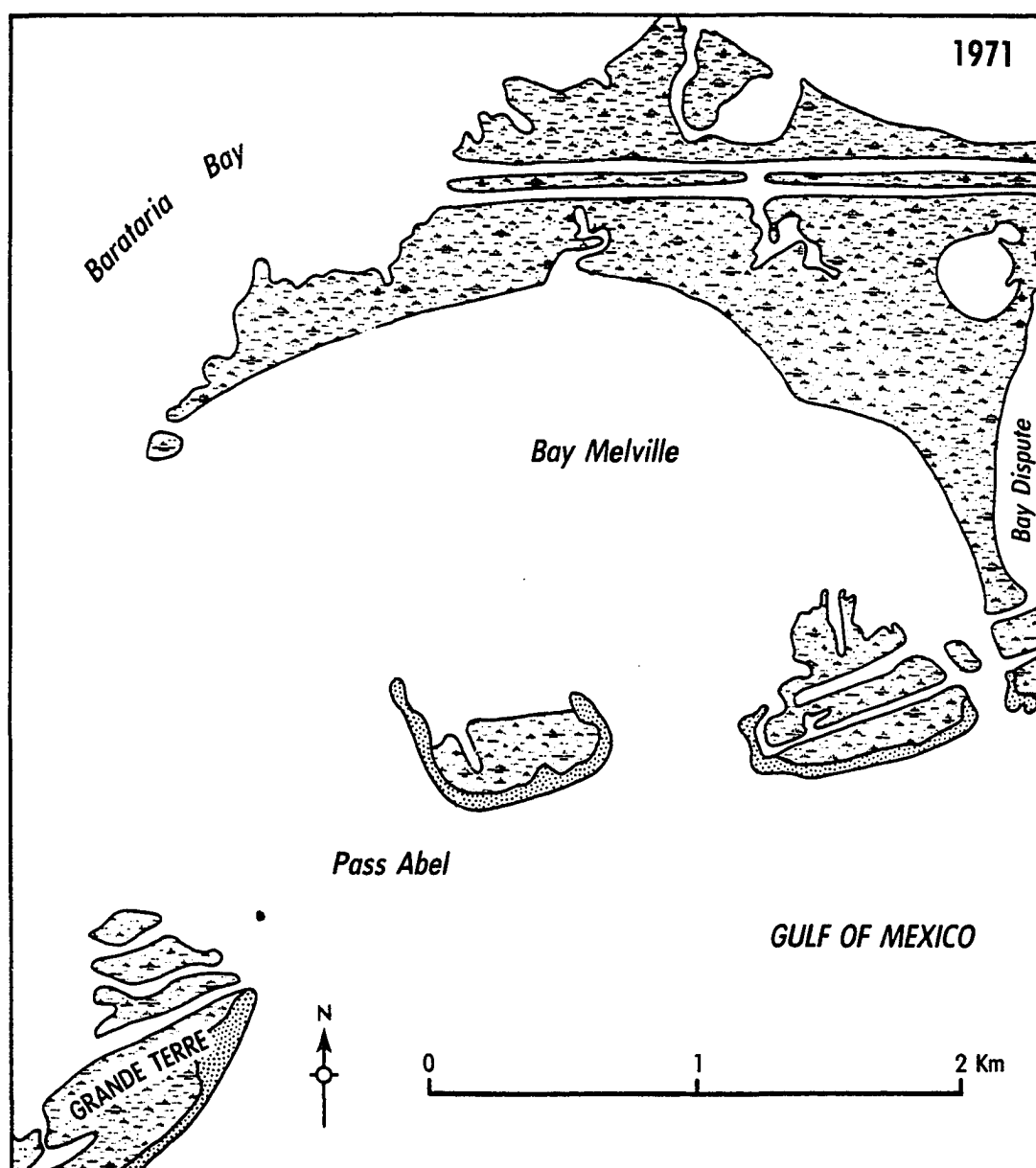


Figure 136. Pass Abel, 1971. The central shoal of Pass Abel in this map is actually a fragmented piece of Grande Terre.

in the barrier (Figure 137). There is a deep narrow channel on the western side of the inlet and a flood tidal delta in Bay Melville. The ebb tidal delta size remains masked by ebb tidal deltas of Barataria Pass to the west and Quatre Bayou Pass to the east.

### **Quatre Bayou Pass**

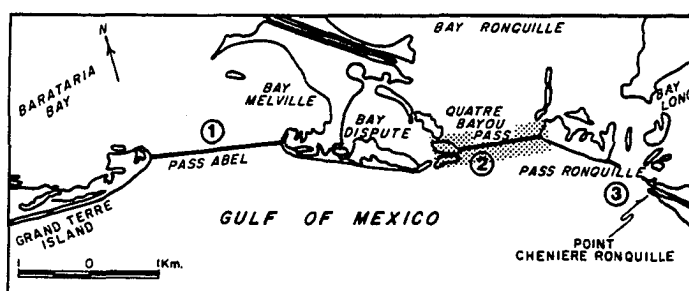
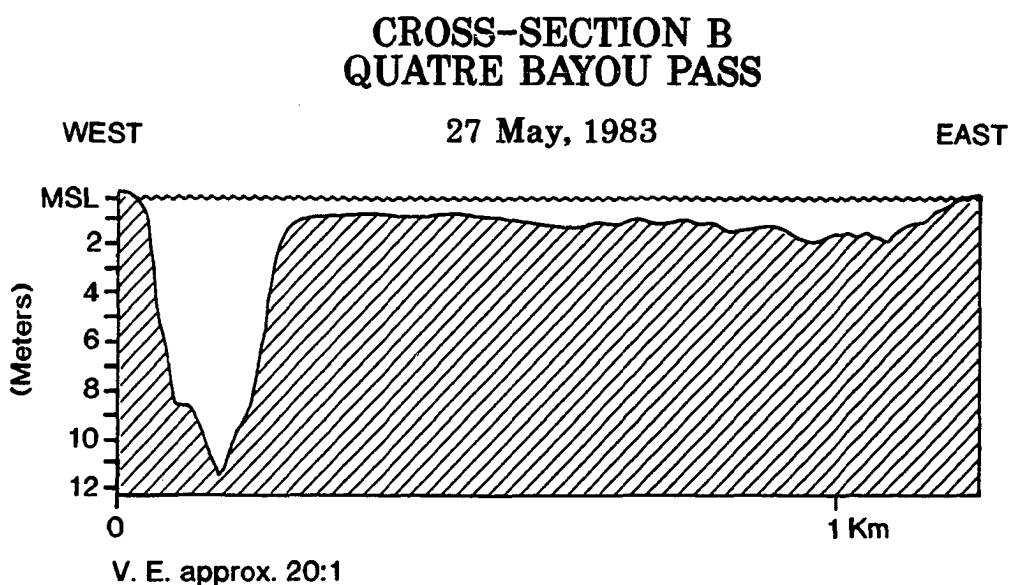
#### **Geomorphology**

Quatre Bayou Pass is a tide-dominated inlet located between Pass Abel and Pass Ronquille (Figure 138). It is fed by Bay Ronquille which has numerous hydraulic connections with Barataria Bay. The main thalweg is deep (12 m) and narrow (150 m). The channel, located at the western margin of the pass opening, shallows to a meter deep platform that extends nearly a kilometer to the east side (Figure 138). The channel width comprises only 12 per cent of the total yet contains over 60 per cent of the inlet throat cross-sectional area.

On the east side of the pass levees of Cat Bayou (Figure 98) appear as vestiges of the last distributary channel to flow through the area. A subtidal flood tidal delta is present to the east of the main channel defined only by changes in sedimentological characteristics (Howard, 1982). A large ebb tidal delta platform has been mapped by Howard (1982) seaward of the pass.



Figure 137. Aerial photograph of Pass Abel, 1983. The crest of the flood tidal delta is visible in this photograph. The inlet thalweg hugs the eastern shoreline.



CROSS-SECTION & CORE LOCATION MAP

Figure 138. Quatre Bayou Pass bathymetric profile. Even though the channel area comprises only 25 % of the pass width, it contains nearly 60 % of the total inlet cross-sectional area.

### Stratigraphy

At least two periods of distributary influence directly affected the present channel at Quatre Bayou. Core QBP-S-2 penetrated the east channel bank and recorded a 1.5 m crevasse sequence between -8 and -6.5 m (Figure 90). Core QBP-S-1 taken even further to the east contained more distal splay deposits at similar depths. It appears from this strike section that the present location of Quatre Bayou Pass occupies a former distributary channel of the Bayou Blue progradation. The lower units of Transect QBP-B, below -5.0 m contain proximal overbank units of Bayou Blue all along the western flank of Quatre Bayou Pass (Figure 89). Evidence of the early Mississippi Delta lobe is located between -2.5 and -1.0 m and parallels the antecedent channel that Quatre Bayou Pass now follows. Carbon-14 dates of roots taken from proximal overbank sequences (Core QBP-B-4) indicate that this splay sequence formed 700 YBP. Distributaries from the Mississippi lobe progradations appear to have followed this old Bayou Blue channel.

### Map History

1817: Although not shown in any detail, an opening is mapped on the east end of Grand Terre in this early, large scale map (Figure 115) that is roughly where Quatre Bayou Pass is presently located. No bathymetry or shoaling is marked on the map that would permit comment on its morphology.

1842: The bathymetry of Quatre Bayou Pass was first mapped



in 1842 (Figure 125). The levee-bound channel is nearly intact several kilometers inland. The lobate, vegetated features seen to occur at right angles to the Cat Bayou levees and filling Bay Ronquille are splay deposits. A similar feature occurring just landward of the inlet throat may also be a crevasse splay, but is also consistent with the morphology and location of an intertidal flood tidal delta. It is not possible to determine the detailed bathymetry seaward of the pass. However, contoured isobaths do outline a small ebb tidal delta.

**1883/1886:** A compilation of older hydrographic and planimetric surveys (USCGS, 1883, 1886) by Howard (1982) allows a reasonably accurate depiction of Quatre Bayou Pass at that time (Figure 125). The levees of Cat Bayou are deteriorating and riddled with breaches. The inlet morphology at this time appears transitional (Hubbard et al., 1979) with shoals located within the pass throat. A small ebb-tidal delta is present at this time. Coincident with the changes in the pass morphology the marsh is fragmenting producing new conduits for bay tidal waters to be exchanged.

**1934:** The bathymetry of Quatre Bayou Pass in 1934 is strikingly different than depicted in previous charts (Figure 125). A meandering eight meter deep, narrow channel was mapped on the west side of the inlet opening where none had previously been. Maximum depths in Cat Bayou

were barely half that of the new channel. Cat Bayou levee continued to erode and caused the opening of Quatre Bayou to widen. The two meter isobath outlines the landward limit of the ebb tidal delta. At this point in time it extends nearly a kilometer further seaward than noted in 1883.

1981: The western channel has scoured to depths exceeding fourteen meters while the pass boundaries continue to widen (Figure 139). Cat Bayou has filled and its levee has nearly disappeared. Further, the terminal-lobe of the ebb tidal delta has extended further seaward of its 1934 position. There has been an apparent redirection of the inlet thalweg to the south-southeast. The channel that had previously extended seaward into the ebb tidal delta has filled.

### Pass Ronquille

#### Geomorphology

Pass Ronquille is located between Quatre Bayou Pass and Point Chenier Ronquille (Figure 140). It is backed by both Bay Long and Bay Ronquille. Bay Ronquille is openly connected to Bay Long. The inlet throat is relatively featureless except for a minor 1 meter deep channel on its east side (Figure 140). An areally extensive flood-tidal delta lies landward of the pass opening (Figure 62). Lobes of the flood-tidal delta wrap around subaerially exposed

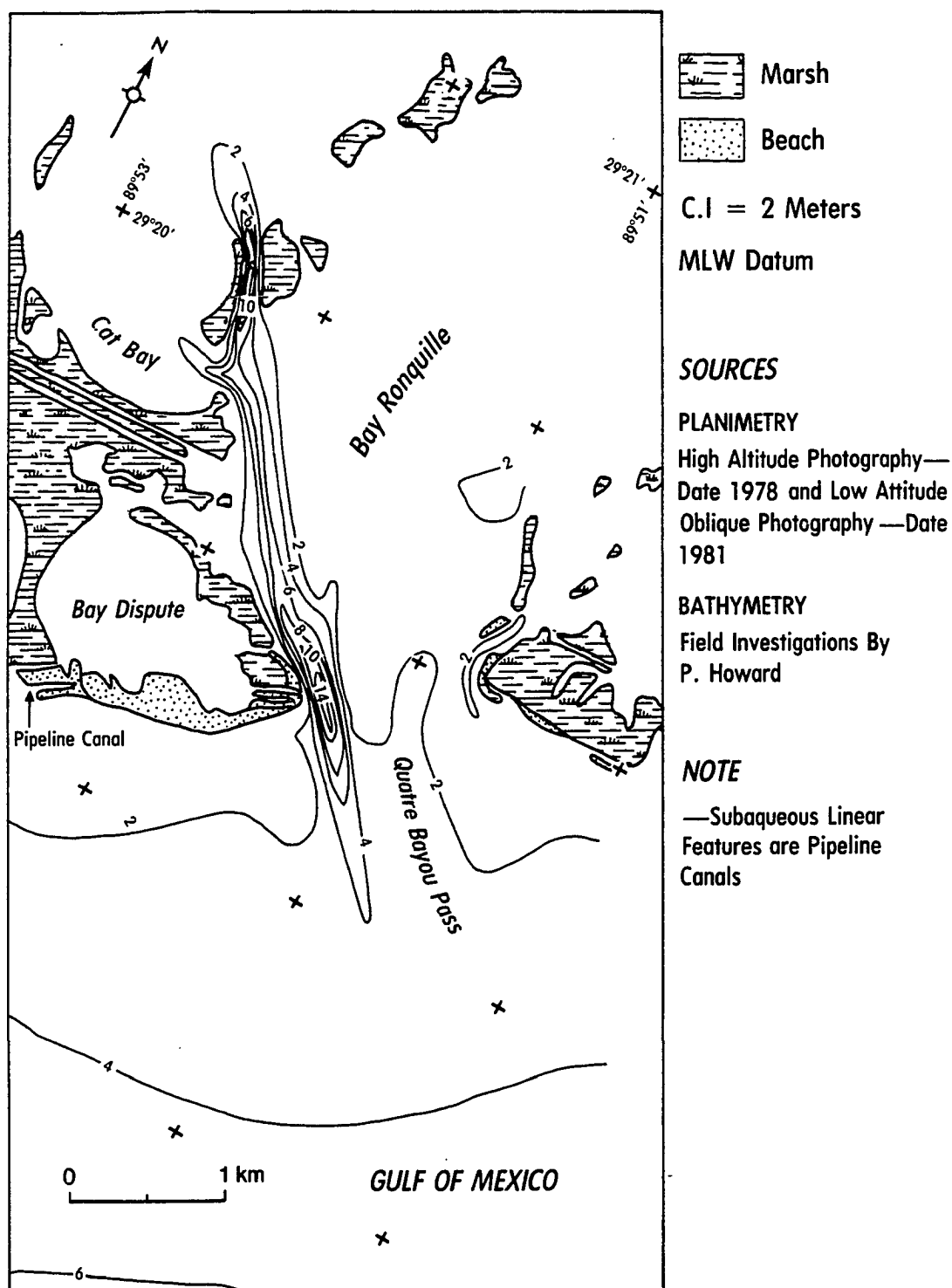


Figure 139. Quatre Bayou Pass, 1981. Since 1934 the Pass opening of Quatre Bayou has been pushed nearly a kilometer landward. The 1981 channel thalweg is straighter than that depicted in the 1934 map.

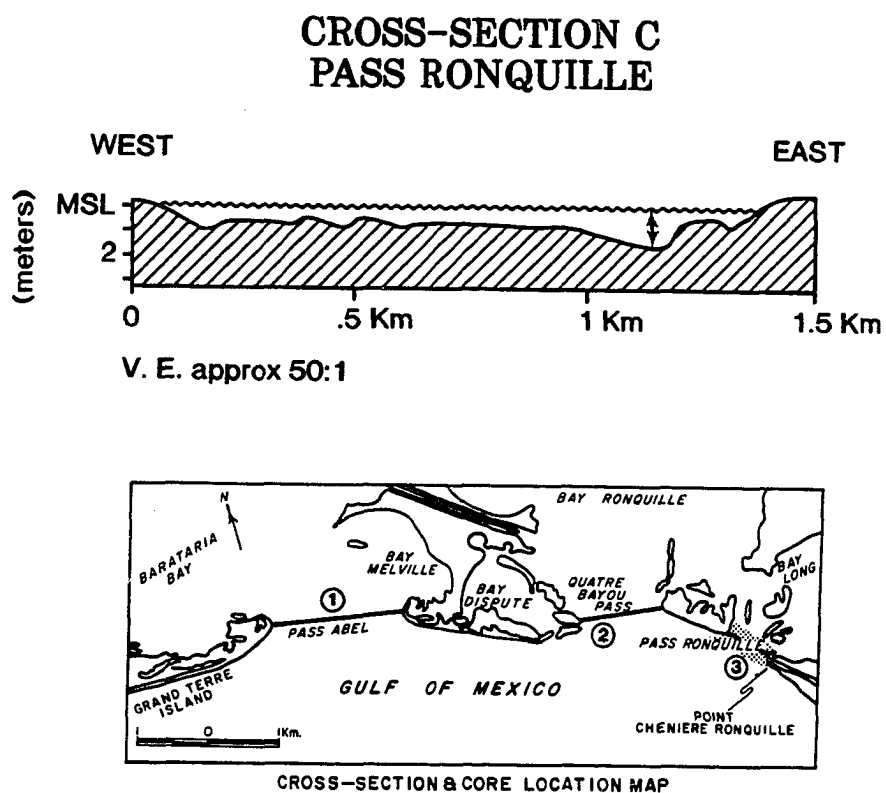


Figure 140. Pass Ronquille bathymetric profile.

remnants of a past deposit formed the Cat Bayou levee breached and built a sub delta into Bay Ronquille (Figure 98). An ebb-tidal delta is not observed seaward of this Pass. Even if one were present, it would probably be masked by features of Quatre Bayou Pass.

### Stratigraphy

A strike section across the opening of Pass Ronquille reveals a continuous layer of marsh at approximately - 1.5 m. The marsh is overlain by horizontally bedded, shelly sands interpreted to be washover from a breached barrier. Marsh material retrieved from a depth of 1.2 m was C-14 dated at 150 YBP (Figure 98). The date extracted from the marsh corroborates Barnard's 1841 map of this area which exhibited marsh in the present position of the pass opening (Figure 125).

### Map History

1841: Pass Ronquille had not yet been breached (Figure 125) Chenier Ronquille is intact and separates Bay Long from the Gulf of Mexico. The only opening into the bay is through the breach in the eastern levee of Cat Bayou.

1886: The pass opening connecting Bay Long with the Gulf has enlarged considerably (Figure 125). The remnants of Cat Bayou separate newly-formed Pass Ronquille from Quatre

Bayou Pass. Bayward located features of the former splay give the appearance of a flood-tidal delta. There is not a visible-ebb tidal delta associated with the pass.

1934: Shoreline erosion has pushed the Pass Ronquille opening landward. The centrally located feature observed in Figure 125 is probably a combination of a deteriorating levee segment and flood tidal delta. According to a 1934 survey recurve spits have formed at the new opening. The nearshore bathymetry is probably still dominated by Quatre Bayou Pass. There were no depth measurements plotted for the new opening. Examination of older maps of this area suggests that a survey would have been performed if a navigable channel were present.

1982: According to more recent aerial mapping efforts and field reconnaissance a large lobate flood tidal delta has formed at Pass Ronquille. Coincident with this the back bay marsh is fragmenting allowing an open connection between Bay Ronquille and Bay Long .

## DISCUSSION

### Inlets in Low Profile Flanking Barriers

#### Pass Ronquille

It was not until 1886 that the coastline in the Ronquille area had eroded far enough landward to create a pass opening into Bay Long (Figure 125). Historical data and cores taken across Pass Ronquille support the fact that

the new opening between the bay and the gulf was created when rising sea level flooded a low-point in the Grande Terre Barrier shoreline. The alignment of the pass opening with the axis of Bay Long behind it may be promoting the permanence of the new pass opening.

### Pass Abel

Early maps from 1816 show a wave-dominated breach at the present location of Pass Abel. By 1841 the breach had recurve spits and a rudimentary ebb tidal delta. The ephemeral nature of this inlet opening is illustrated by Leach and Turtle's 1887 map of the delta plain which did not show Pass Abel where it had previously been documented (Figure 109). By 1937 two small channels were noted that cut through the flood tidal delta and deepened abruptly to 4 meters at the pass opening. Expansion, deepening and construction of an ebb tidal delta continued through 1971. Pass Abel was initially formed at a breach point in the Grande Terre Barrier. In time, Pass Abel captured more Barataria Bay tidal prism and the pass remained open permanently.

### **Inlets Occupying Antecedent Distributary Channels**

Stratigraphic evidence also shows that Pass Abel was the past location of a distributary channel. Historical data and vibracores support the hypothesis that both Quatre Bayou Pass and Pass Abel occupy relict distributary channel

locations. Where distributary channels have become tidal inlets following delta lobe abandonment their narrow channels can open directly to the Gulf. Cat Bayou, mapped by Barnard, 1841, is an excellent example of an inlet occupying a distributary channel; complete with a reach of levee and crevasse splay deposits (Figure 98). An ebb-tidal delta is present. The position and morphology of a small lobate feature just landward of the Cat Bayou Pass throat may be either a flood-tidal delta or another splay deposit. This feature has been removed by recent shoreface retreat.

A comparison of historical maps and charts dating back to 1842 indicate that Quatre Bayou has undergone a major shift in thalweg location in response to changes in the back bay configuration. Channel switching of Quatre Bayou Pass from east to west appears to have been initiated just prior to the publishing of the 1883-1886 map of Quatre Bayou Pass. Through time the combined tidal prism of Cat Bay and Bay Ronquille has excavated through this western channel causing it's entrenchment to depths greater than 8 meters below mean sea level by 1934 (Figure 125). The outline of this channel can be traced through breaks between deteriorating marsh parcels observed in the 1883/1886 shoreline map (Figure 125). The old Bayou Blue channel filled following establishment of the new channel.

By 1982 the gulf opening of Quatre Bayou Pass had widened considerably. The deep channel was approximately



one hundred and fifty meters wide and nearly twelve meters deep (Figure 138). A shallow (1 meter deep) platform extended eastward nearly a kilometer to the headland that separates Quatre Bayou and Pass Ronquille.

### **Inlet Migration**

The process of coastwise migration of tidal inlets has been the subject of many studies (Boothroyd, 1985; Bruun and Gerritson, 1959; FitzGerald, 1984). An inlet thalweg is forced in the direction of longshore sediment transport as the downdrift barrier sands spill into the updrift side of the inlet channel. In order to maintain equilibrium with the associated tidal prism the downdrift channel boundary is scoured and migrates laterally. In time the inlet channel becomes hydraulically inefficient, a break is made in the spit closer to its origination and a new route is established (Oertel, 1978). This cycle of spit migration and breaching is a common occurrence in tidal inlets (FitzGerald and Levin, 1981). In contrast, this research has documents that tidal inlets along the Barataria shoreline do not migrate appreciable distances longshore.

The limited lateral migration of tidal inlets in the Barataria Bight that does occur may be explained by the meander geometry of the distributary channels that the passes now occupy. According to Shamban (1985) Barataria Pass has not migrated, but pivoted about a central axis (Figure 141). The inlet thalweg has been redirected from

northerly to north-northwest between 1840 and 1983. Perhaps not coincidentally, this rotation corresponds with the northwest shoreline growth of Grand Isle and modifications to the west end of Grand Terre (Shamban, 1985). The amount of sediment that has been introduced to the system from the west by the Caminada/Moreau Headland (Gerdes, 1985) and structural modifications made by the Army Corps of Engineers appears to have had insignificant impact on inlet channel movement.

A historical analysis of Quatre Bayou Pass (1886 - 1981) by Howard (1982) actually shows no coastwise migration of the channel. The apparent westward migration of the pass between 1934 and 1981 (Figure 125) is the result of shoreface erosion that caused the landward repositioning of the inlet throat. The seaward extension of the channel mapped in 1934 has apparently been filled by shoreface and ebb tidal delta sediments. The channel has remained stationary. Historical analysis of the Pass Abel channel reveals similar stability. The eastern spit of Grand Terre is presently filling the west channel bank of Pass Abel (Figure 54). However, the opposite channel bank has not responded correspondingly by eroding to the east.

Cores taken along the channel walls of Pass Abel and Quatre Bayou Pass indicate that each is encased in significant thicknesses of cohesive fine-grained sediments.

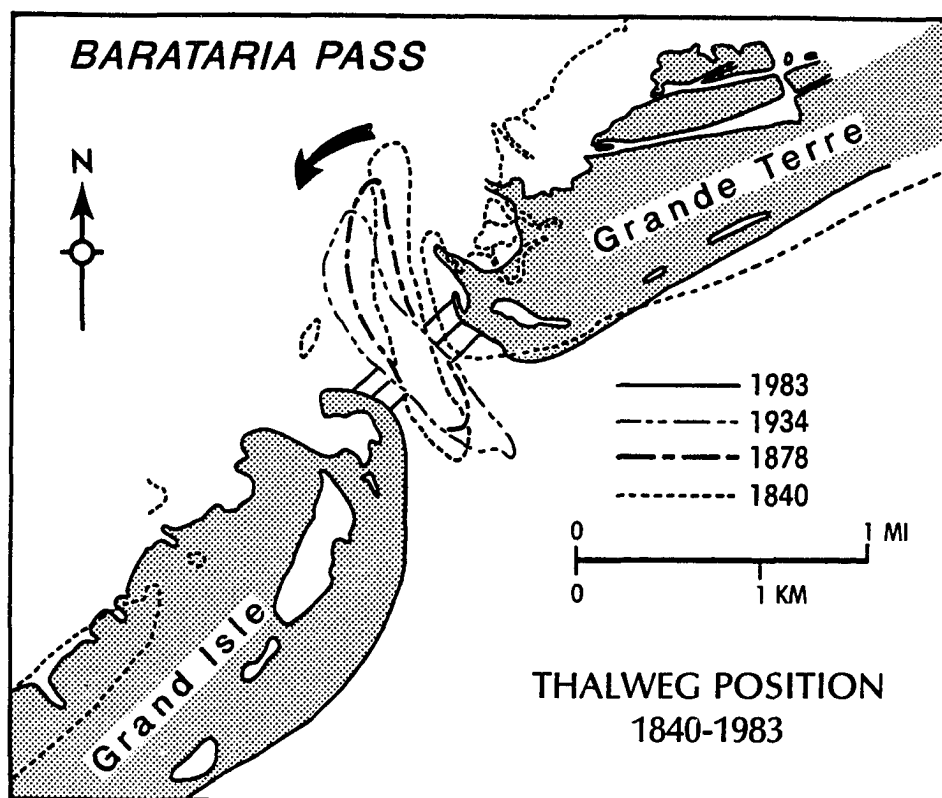
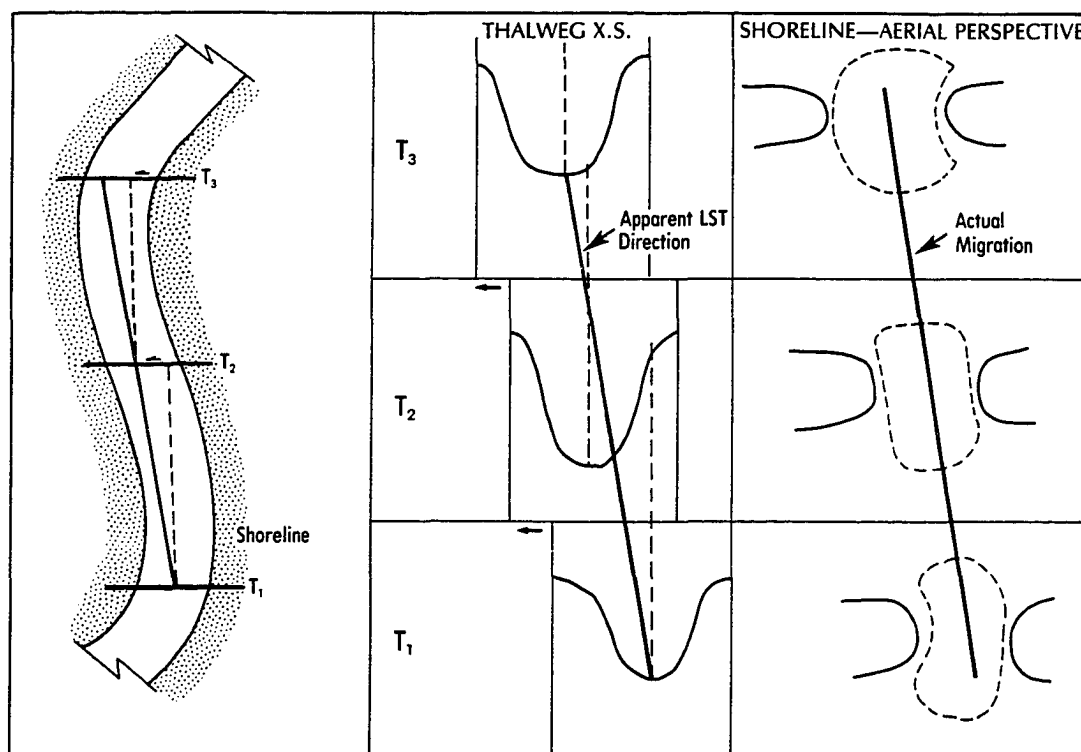


Figure 141. Pivot of Barataria Pass inlet throat (From Shamban, 1985). Barataria Pass is not migrating coastwise. As the shoreline recedes the inlet throat is being resituated in a meander bend of an old distributary system.

When inlets reoccupy distributary channels, downward excavation is probably halted when the sandy channel fill has been eroded and cohesive materials comprise the side-walls. Cohesive material requires significantly higher shear stress to initiate movement than unconsolidated sands (Hjulstrom, 1935). The modification of these channel walls is made even more difficult due to the fact that 1) over time the channel bounding material has compacted and 2) erosion by impact of transported debris is minimized due to the steep side-walls of the narrow deep channels. The location of these passes in older distributary channels explains their resistance to migration.

If Barataria Pass, Pass Abel, and Quatre Bayou Pass are located within relict distributaries then any apparent coastwise migration of the passes would be related to the degree of bend within the meanders of the antecedent channel system that they occupy. As the shoreline surrounding the pass recedes, the inlet throat will be resituated within the antecedent meander position (Figure 142). If the passes occupied channel bifurcations of a common distributary system then shoreline erosion would cause the distance between them to decrease. Without prior knowledge of the pass locations within distributary channels, longshore sediment transport directions would appear opposite within the same coastal cell.



142. Repositioning of inlet throat during shoreline retreat. The westward migration of a distributary-located-inlet is controlled by the antecedent channel axis position.

### Processes Contributing to Inlet Widening

Where there is an adequate longshore sediment supply replenishing the spits inlet evolution is due primarily to changes in tidal prism through bay area enlargement (Figure 128). According to FitzGerald and Nummedal (1983) there would not be a substantial lag time between bay enlargement and the corresponding increase in tidal inlet cross-sectional area.

Restricted sediment supply to the longshore transport system results in inlet widening by erosion of the recurve spits by waves and tides. At Quatre Bayou Pass and Pass Abel the eastern sides of the inlets are sediment starved causing a rapid rate of inlet widening. Sand in the longshore system is trapped in the ebb and flood tidal deltas. Inlet widths essentially doubled at Barataria Pass (Shamban 1985) and Quatre Bayou Pass and increased five-fold at Pass Abel between 1932 and 1971 (Table 6). The Quatre Bayou channel cross-sectional area has increased by a factor of 3.4 from 550 m<sup>2</sup> to 1890 m<sup>2</sup> between 1841 and 1934 (Table 7). The channel cross-section measured again in 1982 had not increased significantly since 1934, despite continued bay enlargement. Inlet cross-sections at Barataria Pass increased by a factor of 1.6 between 1878 and 1934. However, no appreciable increase in channel cross-section has occurred since that time (Shamban, 1985). It appears that the combined pass cross sections within the

eastern Barataria Bight transmits the tidal wave efficiently between the bay and gulf. Wave erosion rather than tidal currents are presently responsible for barrier erosion.

Changes in the width and cross-sectional area of Quatre Bayou Pass were plotted by Howard (1982) (Figure 143). From 1860 to 1920 the channel thalweg width increased by less than twenty meters while a two hundred meter shallow platform was constructed where none had previously been. After 1920 the channel width appears to have stabilized while erosion of the barrier caused accelerated growth of the platform. According to Howard (1982) the channel width increased by an average 7 m/yr. This rate is either unduly conservative or has increased dramatically in recent years. Shoreline surveys demonstrated that wave induced erosion caused Quatre Bayou Pass to widen by 15 meters between February and May of 1983. For comparison, shoreface retreat in this coastal reach approaches 20 meters per year, the fastest eroding shoreline in Louisiana (Nakashima, 1988).

Lateral planation of the barrier shoreline is the result of the following factors: 1) the necessary response of the inlet throat to increasing tidal prisms, 2) sediment supply and 3) the location of the inlet thalwegs within distributary channels. As the back bay marsh in the delta plain subsides, the land masses deteriorate and fragment revealing past distributary positions. The subtle existence

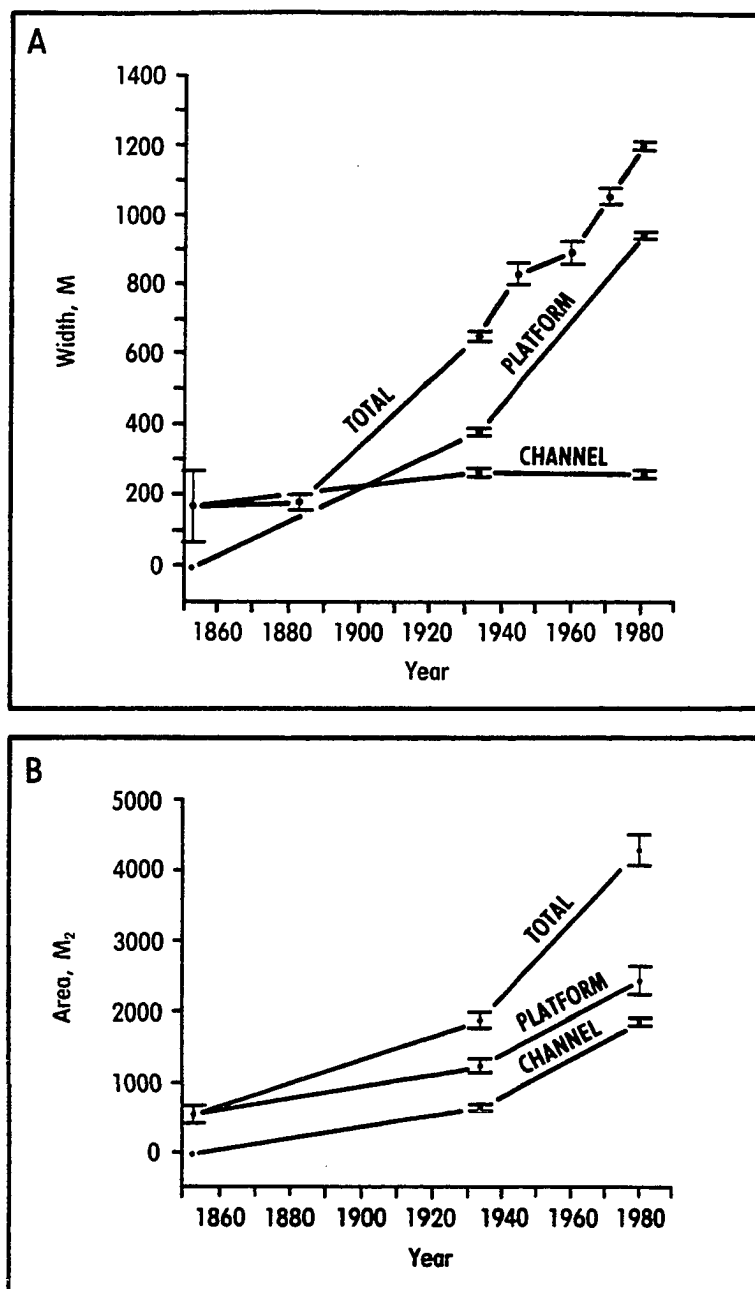


Figure 143. Changes in width (a) and channel cross-sectional area (b) at QBP (from Howard, 1983). Around the turn of the century the channel cross-section has not increased significantly while the shallow platform width has quadrupled. During the same period of time the total pass cross-section has increased dramatically since around 1940.

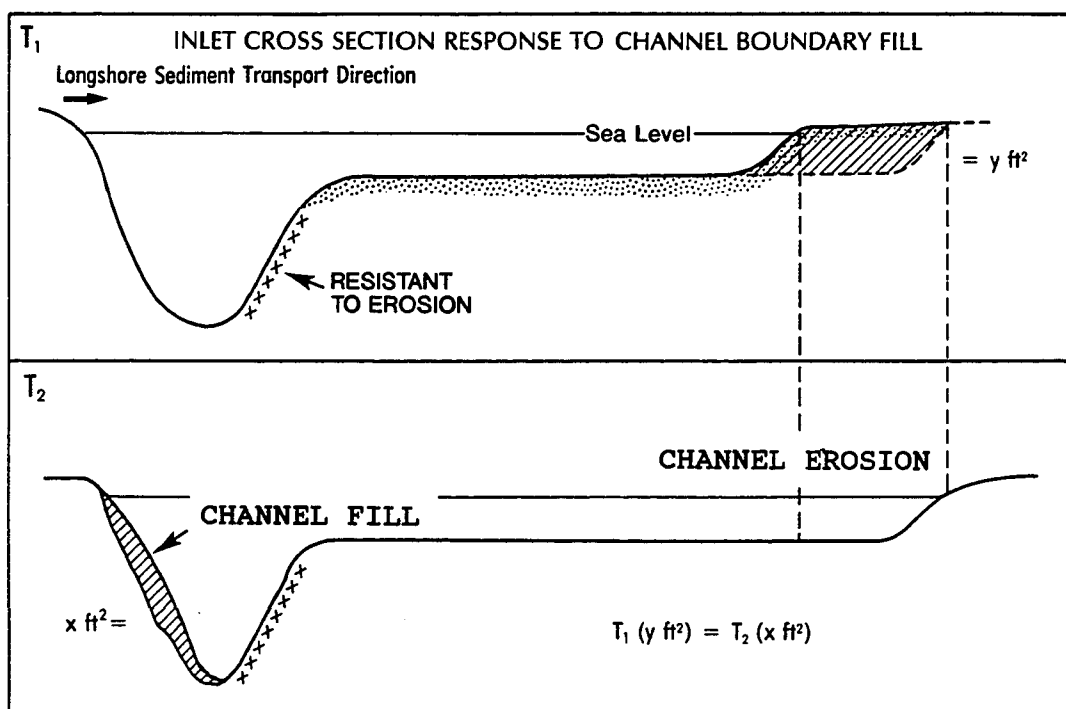


of these relict channels may be keyed to visually imperceptible lower elevations relative to their bounding levees and surrounding marshland. With subsidence the slightly lower channel elevation floods first. Subsequently, this channel becomes a preferred path for tidal exchange and downward erosion is initiated.

As Barataria Bay and Bay Ronquille enlarged, relict channels were excavated. The increase in tidal prism by back barrier expansion necessitated larger inlet cross-sections to transfer the tidal wave between the Gulf and the bays efficiently. Initially the channel cross-section modifications at Quatre Bayou and Pass Abel were effected by downward cutting into the old channel axes.

Once the cohesive sidewalls were encountered, this mechanism of cross section enlargement became inefficient.

The inability of the inlet to modify the cohesive channel sidewalls did not preclude the inlet from otherwise modifying its cross-sectional area and maintain equilibrium with the tidal prism. Instead of modifying the channel proper it was more efficient to sweep the thin veneer of unconsolidated barrier sands off of the underlying bay surface (Figure 144). In time sediment supply to the recurve spits became limiting and the pass widened by wave erosion, regardless of tidal prism increases. Tables 6 and 7 summarize the changes in width and cross-sectional area over time for Barataria Pass, Pass Abel, and Quatre Bayou



144. Diagram of inlet x-section modification by lateral planation of barrier Islands. The non-migratory nature of the deep channel margin causes the shallow barrier sands to be swept off of the fine-grained platform to increase the overall channel cross-sectional area.

Pass. The lateral erosion of barriers in the vicinity of tidal inlets contributes to their transition to inner shelf shoals, the final stage of the barrier evolution (Penland and Boyd, 1981).

#### **Barataria Shoreline Short Term Future**

Once the Barataria shoreline is eradicated several tens of kilometers of open bay will become exposed to open ocean. The new shoreline position would roll back to and become established along the present bay perimeter (Figure 145). Inlets would be situated at bay openings and eventually in re-excavated relict distributary channels. These inlet openings would be largely independent of those located within the present Barataria system except in such cases as the new inlet forms in landward reaches of parent distributary system. The main point is that there would not be a continual translation of tidal inlet pathways following overstepping of the barrier system. When a sufficient sand supply is mined from the bay shoreline a new barrier system may form. If a new shoreline does become established the process of bay enlargement and inlet evolution will recur.

#### **Coastal Land Management Considerations**

Landloss in the Mississippi Delta Plain region is of paramount concern to the state of Louisiana. From the collective, voluminous chapters of this dissertation it becomes clear that landloss must be addressed in the bay and

at the shoreline in order to preserve the Barataria Bay ecosystem. The past chapters have demonstrated that bays expand due to subsidence and erosion, this causes tidal inlets to evolve and contributes significantly to barrier erosion. The barriers erode primarily because of a paucity of sand along within the coastal and nearshore systems. Without nourishment of the barrier beaches they will be quickly be reduced to subtidal shoals.

Wetland restoration within coastal Louisiana will halt bays from expanding and control the temporal increase in tidal prism. The end effect is that tidal currents through the passes will decrease. However, because of the present, high rate of transgression occurring along the delta barrier shoreline, the wetlands restoration program must be integrated with fortification of the barrier shoreline. In the Barataria region Grande Isle and Grande Terre represent the most important barrier to the Gulf saline waters. If they are left in their present state there will be little use for wetlands restoration programs in the near future.

## CONCLUSIONS

1) Tidal inlets in eastern Barataria Bay are located in old distributary channels, at overwash breaches in low profile barrier systems, or combinations of these. Pass Abel, and Quatre Bayou Pass are located in old distributary channels. However, Pass Abel was initially located in a low profile

shoreline. Pass Ronquille is located where a protective barrier subsided offering a free connection to the back bay.

2) Where sediment supply is available to longshore transport processes inlet evolution from wave to tide dominated is governed principally by tidal prism which increases temporally by bay enlargement. When sediment supply becomes limiting inlets will widen, tidal currents through the inlet will decrease and inlet morphology will become more wave influenced.

3) Minimal lateral migration of tidal inlet channels, sometimes in directions opposite to dominant longshore currents, is tied to the cradling of the pass thalweg within old distributary channel reaches. As a shoreline is eroded landward, the pass will be resituated in the successive position of the antecedent channel.

4) Rapid lateral planation of the barrier is the result of increasing tidal prisms, decreasing sediment supply and the location of tidal inlets in old distributary channels. The inability of muddy channel sidewalls to be modified does not preclude the inlet from otherwise modifying its geometry. In coastal Louisiana channel cross sections are increased by sweeping the thin subaerial veneer of unconsolidated sands which comprise adjacent barrier systems and headlands. The efficiency of this process causes significant lateral erosion in the Barataria shoreline system.

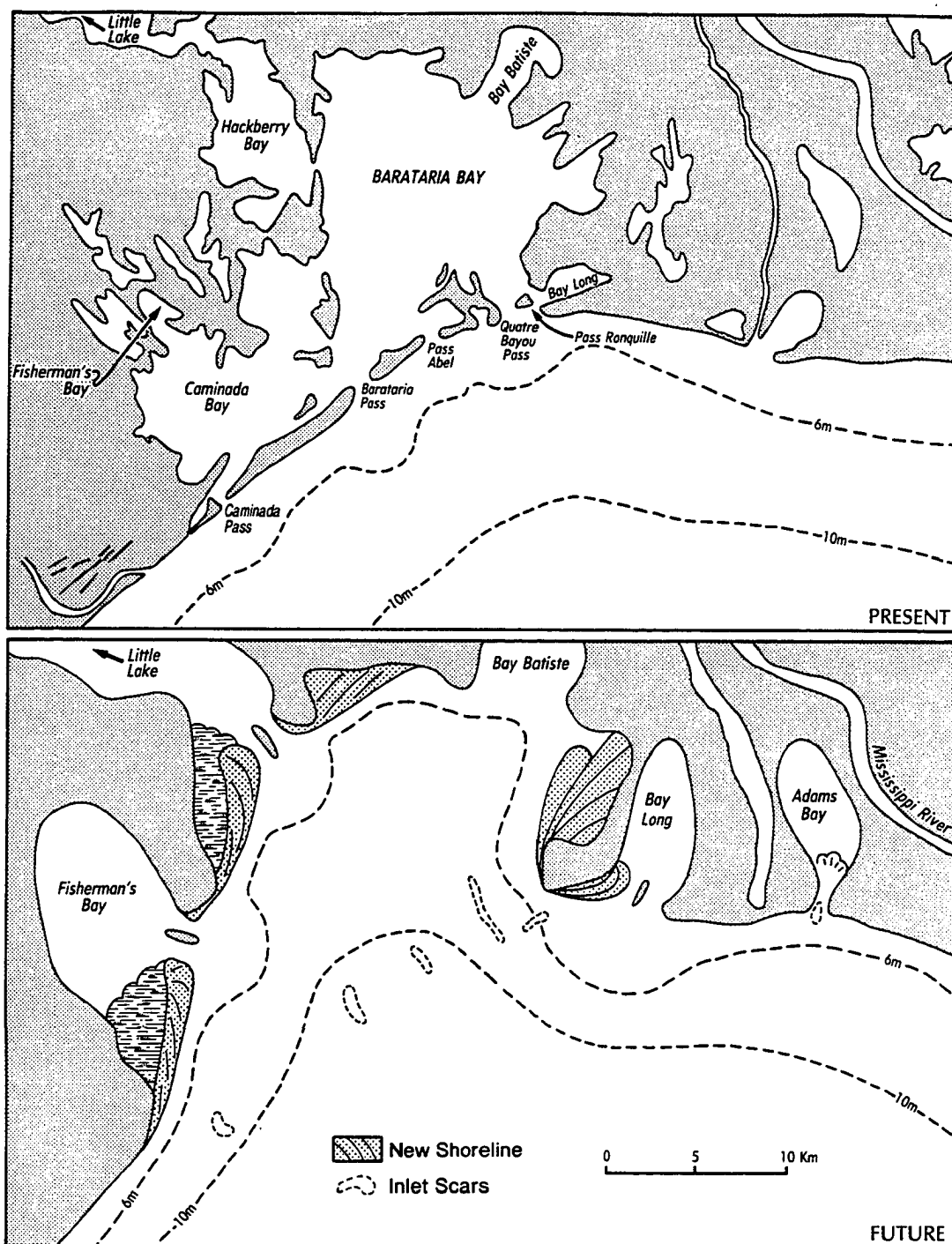


Figure 145. Location of new Barataria shoreline following complete erasure of the present barrier system. Successive bay/shoreface transgressions would have inlet scars separated by the open water dimension of the ancestral bay.

## 12. COLLECTIVE DISSERTATION CONCLUSIONS

1) The early chronology of Bayou Des Families, and Bayou Blue should be modified to reflect the chronologies determined from this study. The Mississippi Lobe should be recognized as having an early and late phase of delta progradation.

2) The limit of shoreface transgression during the abandonment phase of the Bayou des Families delta lobe history cannot be ascertained from this data set. However, the landward limit of the bay ravinement limit lies 9 kilometers landward of the present shoreline. The regional, coastwise extent of this shoreline retreat cannot be evaluated.

3) The Bayou Blue Bay Ravinement limit is located 1 kilometer landward of the present shoreline. The shoreface portion of this transgression can be traced from the Caminada headland to the northeast where it is lost beneath the present path of the modern Mississippi River channel. Portions of the barrier shoreline present during the Bayou Blue transgression were cored beneath the Chenier Ronquille area of the study area. This shoreface retreat appears to have been regional, affecting shorelines away from the influences of the Bayou Blue progradation.

4) Grand Terre is part of a strand plain formed during the abandonment phase of the Mississippi Delta Lobe Progradation. Grande Isle is younger than Grand Terre, and was formed following the Late Lafourche delta progradation.

5) A review of delta plain processes and statistical analysis of Carbon-14 dates collected along the delta plain suggest that eustatic rise and fall of sea level in the Gulf of Mexico has contributed to the geologic framework of the Barataria offshore, and likely to the entire Mississippi River delta plain.

6) Rates of subsidence in the delta plain decrease with depth. Near surface rates of subsidence near 1.0 cm/yr decrease to approximately 0.26 cm/yr and 0.14 cm/yr at 3 and 5m depth, respectively.

7) Five inlet morpho-types occur along the shoreline of the Mississippi River Delta Plain. They are 1) young wave-dominated with intertidal flood tidal deltas, 2) young transitional with shoals choking the inlet throat, 3) tide-dominated inlets exhibiting deep channels and large ebb tidal deltas, 4) older transitional inlets with ebb tidal deltas flattened landward at the terminal lobe, infilling tidal channels and spits detached from the adjacent barriers, and 5) older wave-dominated inlets with subtidal flood tidal deltas.

8) Tidal inlet morphology along this coast is correlated to the relative age of the delta lobe system in which it is contained. In stage 1 of the barrier island model an associated temporal increase in bay area (and tidal prism) following delta lobe abandonment causes tidal inlets to



evolve from wave dominated to tide dominated morphologies with a transitional stage in between . In flanking barrier systems sediment supplied to adjacent, channel confining spits is not limiting.

9) By limiting sediment supply barriers fragment and tidal inlets widen faster than relative increases in tidal prism produced by bay expansion. Tidal currents decrease and inlets of late stage 1, flanking barrier islands, and early stage 2, barrier island arc systems, that were once tide-dominated develop wave influenced morphologies evolving to old transitional and finally to old wave-dominated inlets.

10) Where sediment supply is available to longshore transport processes inlet evolution from wave to tide dominated is governed principally by tidal prism which increases temporally by bay enlargement. When sediment supply becomes limiting inlets will widen, tidal currents through the inlet will decrease and inlet morphology will become more wave influenced.

11) The temporal change in inlet morphology is concurrent with tidal prism increase due to back bay enlargement. As tidal prism through the inlet increases wave influenced inlet sand bodies are less prevalent. During later stages when tidal currents decrease, waves again become dominant within the inlet. That this evolution takes place while holding average

wave heights and tidal range constant demonstrates the influence that tidal prism has on local inlet morphology.

12) Tidal inlets in eastern Barataria Bay are located in old distributary channels, at overwash breaches in low profile barrier systems, or combinations of these. Pass Abel, and Quatre Bayou Pass are located in old distributary channels. However, Pass Abel was initially located in a low profile shoreline. Pass Ronquille is located where a protective barrier subsided offering a free connection to the back bay.

13) Minimal lateral migration of tidal inlet channels, sometimes in directions opposite to dominant longshore currents, is tied to the cradling of the pass thalweg within old distributary channel reaches. As a shoreline is eroded landward, the pass will be resituated in the successive position of the antecedent channel.

14) Rapid lateral planation of the barrier is the result of increasing tidal prisms, decreasing sediment supply and the location of tidal inlets in old distributary channels. The inability of muddy channel sidewalls to be modified does not preclude the inlet from otherwise modifying its geometry. In coastal Louisiana channel cross sections are increased by sweeping the thin subaerial veneer of unconsolidated sands which comprise adjacent barrier systems and headlands. The efficiency of this process causes significant lateral erosion in the Barataria shoreline system.

### 13. EXECUTIVE SUMMARY

The length and breadth of this dissertation has resulted in over a dozen conclusions regarding the various processes that have occurred during the building of the Mississippi River Delta plain. In the following paragraphs the findings that are most relevant to the present populace of Louisiana will be elucidated.

The coastline of Barataria Bight from Caminada Inlet to Chenier Ronquille is one of the fastest retreating shorelines in the country. The evolution of tidal inlets along this shoreline shows that the landward retreat of shoreline, though important, is only one of the major processes contributing to the demise of Louisiana barrier systems. Tidal prism increase resulting from bay enlargement, combined with temporally decreasing sediment supplies brought to the shoreline by riverine or longshore sediment transport, and the reoccupation of old distributary systems by inlet systems cause the barriers to erode laterally by tidal inlet processes. The combination of coastwise barrier erosion and landward shoreface retreat causes the rate of barrier erosion to accelerate.

The present mitigative efforts involving the restoration of wetlands are only a partial solution to slowing landloss along the delta plain. The cycle of delta lobe progradation and abandonment in the Barataria region has revealed that the shoreline has retreated at least as

far as the present Barataria barriers during the Bayou Blue transgression some 2000 years ago. The barrier shoreline built during this transgression protected an ancestral Barataria Bay. Kusters (1987) describes a vertical core sequence in which this ancestral bay is buried beneath a facies indicative of more open water exposure. This sequence was probably caused by the demise of the seaward lying protective barrier. During the abandonment phase of the Bayou Blue delta lobe, shoreface retreat was probably also effected by a combination of lateral erosion within the tidal inlets and landward shoreface retreat. Historically, sediment supply to the barriers has probably been the controlling factor regarding the fate of the landward bays and related wetlands.

Assuming that this interpretation is accurate, the present programs involving restoration of wetlands within Barataria Bay and other locations along the Mississippi River delta plain should also consider barrier island renourishment in the mitigative plans. The fortification of the barrier islands fronting the bays will contribute to the successful restoration of the bayward ecosystems.

## REFERENCES

- Adams, R.D., Barrett, B.B., Blackmon, J.H., Gane, B.W. and McIntyre, W.G. (1976) Barataria Basin: Geologic processes and framework. Center for Wetland Resources, Louisiana State University, Baton Rouge, La, Sea Grant Pub. No. LSU-T-76-006, pp117.
- Allen, J.R.L. (1970) Sedimentation in the modern delta of the River Niger, West Africa. in J.P. Morgan (ed) Deltaic Sedimentation, Modern and Ancient Society of Economic Paleontologists and Mineralogists Special Publication No. 15, 138-151.
- Anderson, F.E. (1974) The effect of boat waves on the sedimentary process of a New England tidal flat. Technical Report no.1, Department of Earth Sciences, Univ. of New Hampshire, Durham, New Hampshire, p38.
- Andrews, P.B. (1970) Facies and genesis of a hurricane washover fan, St. Joseph Island, Central Texas Coast. Bureau of Economic Geologists, University of Austin, Rep. Investigation 67,1-147.
- Baumann, R. and R.D. De Laune, (1982) Sedimentation and apparent sea-level rise as factors affecting land loss in coastal Louisiana. Pages 2-13 in D.F. Boesch, (ed) Proceedings of conference of coastal erosion and wetlands modification in Louisiana: causes, consequences, and options. U.S. Fish and Wildlife Service, Biological Services Program, FWS/OBS-82/59.
- Blum J.L., (1968) Salt marsh Spartina and associated algae. Ecol.Monogr., 38, 199-221.
- Boesch, D.F., D.R. Levin, D. Nummedal, and K. Bowles., (1983) Subsidence in Coastal Louisiana: Causes, Rates, and Effects on Wetlands. U.S. Fish and Wildlife Service, Division of Biological Services, Washington, D.C. FWS/OBS-83/26. pp30.
- Boothroyd, J.C. (1985) Mesotidal Inlets and Estuaries. in R.A. Davis, Jr. (ed) Coastal Sedimentary Environments. Springer Verlag. p287-360.
- Bowles, K. (1987) Sedimentologic and stratigraphic framework of some modern crevasse splay sands, Baptiste Collette, Louisiana. unpubl. Masters Thesis. Department of Geology, Louisiana State University. pp179.

- Boyd R. and S. Penland. (1981) Washover of deltaic barriers on the Louisiana Coast. Transactions of the Gulf Coast Association of Geological Societies, 31, 243-248.
- Britsch and May (1987) Louisiana Shoreline Mapping Program. United States Geological Survey.
- Bruun P. (1986) Morphological and Navigational Aspects of Tidal Inlets on Littoral Drift Shores. Journal of Coastal Research. 2, 123-146.
- Bruun P. and Adams J. (1988) Stability of Tidal Inlets: Use of Hydraulic Pressure for Channel Stability. Journal of Coastal Research. 4 (4) 687-701.
- Bruun, P and Gerritsen, F. (1960) Stability of Coastal Inlets, Amsterdam, Holland, pp123.
- Byrne, R.S., Bullock, P., and Tyler, A.G. (1975) Response characteristics of a tidal inlet, a case study, in Cronin, L.E., (ed), Estuarine Research, New York, Academic Press, 2, 201-216.
- Cain, T.J. (1972) The reproductive cycle and larval tolerances of Rangia cuneata in the James River, Virginia. Ph.D. Dissertation. Univ. of Va., Charlottesville. 121 p.
- Coleman, J.M. (1966) Recent coastal sedimentation: Central Louisiana Coast, Louisiana State University Press, Baton Rouge, Louisiana, p58-73.
- Coleman, J.M. (1981) Deltas, processes of deposition and models for exploration. Minneapolis, Burgess Publishing Company, 2nd ed., pp124.
- Coleman J.M. and S.M. Gagliano (1964) Cyclic sedimentation in the Mississippi River deltaic plain. Transactions of the Gulf Coast Association of Geological Societies. 14, 67-82.
- Coleman, J.M., S.M. Gagliano and J.E. Webb (1964) Minor Sedimentary Structure in a prograding distributary. Marine Geology 1, p.240-258.
- Coleman, J.M. and D.B. Prior (1980) Deltaic Sand Bodies. American Association of Petroleum Geologists, continuing education note series no. 15, pp171.
- Coleman J.M. and W.G. Smith (1964) Late Recent rise of sea level, Geological Society of America Bulletin., 75, 833-840.

- Coleman, J.M. and L.D. Wright (1975) Modern river deltas: variability of processes and sand bodies, in Broussard, M.L. (ed), Deltas-Models for Exploration. Houston Geological Society, pp99-150.
- Colquhoun D.J., M.J. Brooks, W.B. Abbott, F.W. Stapor, W.H. Newman, and R.R. Pardi (1981) Location of Archeological Sites with respect to sea level in the Southeastern United States. in L.K. Konigsson and K. Paabo, (eds)Florilegium Florinis Dedicatum. Striae, 14,144-150.
- Conner W.H., and Day J.W. Jr. (1988) Rising water levels in coastal Louisiana; Implications for two forested wetland areas in Louisiana. Journal of Coastal Research, 4(4), 589-596.
- Cowdon, J. (1877) The Barataria Ship Channel and its importance to the valley of the Mississippi. Report to the Army, Part of Louisiana Collection, Louisiana State University, Baton Rouge, Louisiana p41
- Davies D.K., F.G. Ethridge, and R.R. Berg (1971) Recognition of barrier environments. Bulletin American Association of Petroleum Geologists. 55, 550-565.
- Davies, J.L. (1980) Geographical Variation in Coastal Development, 2nd ed - (Geomorphology Text 4) Longman, Inc. NY, pp 212.
- Davis, R.A. Jr. and Hayes, M.O. (1984) What is a wave dominated coast? in: B.Greenwood and R.A. Davies, (eds) Hydrodynamics and Sedimentation in Wave Dominated Coastal Environments. 60:313-329.
- Day, Jr., W. Smith, W.G. Wagner, and W.C. Stowe (1973) Community Structure and Carbon Budget of a Salt Marsh and Shallow Bay Estuarine System in Louisiana. Publ. LSU-SG-72-04, Louisiana State Univ., Center for Wetland Resources, Baton Rouge, La. 79 pp.
- Dolan, R, B. Hayden and L. Vincent (1974) Crescentic coastal landforms. A. Geomorphology, 18: 1-12.
- Donaldson, A.C., R.H. Martin, and W.H. Kanes. (1970) Holocene Guadalupe Delta of Texas Gulf Coast. in J.P. Morgan, (ed) Deltaic Sedimentation, Modern and Ancient, Society of Economic Paleontologists and Mineralogists special publication No. 15, p3-30.
- Dott, R.H. (1966) Eocene deltaic sedimentation at Coos Bay, Oregon: Journal of Geology. 74,373-420.

- Elliott, A.J. (1978) Observations of meteorologically induced circulation in the Potomac estuary. Estuarine Coastal Marine Science 6, 285-299.
- Erxleben, A.W. (1975) Deltaic and related carbonate systems in the Pennsylvania Canyon Group of North Central, Texas, in Broussard, M.L. (ed) Deltas: models for exploration. Houston Geological Society. pp555.
- Evans, O.F. (1942) The origin of spits, bars, and related structures. Journal of Geology 50,658-659.
- Farrell, K., (1990) Characteristics of fluvial depositional systems in the Mississippi River, Louisiana. unpubl. phd dissertation. Department of Geology. Louisiana State University, Baton Rouge, Louisiana. pp. 385
- Fisher, W.L., L.F. Brown, Jr., A.J. Scott, McGowen, J.H., and others (1969) Delta systems in the exploration for oil and gas -a research colloquium: Austin, Tx. Univ. Texas, Bur. Econ. Geology, pp78.
- Fisk, H.N. (1944) Geological Investigation of the alluvial valley of the lower Mississippi River. U.S. Army Corps of Engineers, Mississippi River Commission, Vicksburg, Miss. pp78.
- FitzGerald, D.M. (1984) Interactions between the ebb tidal delta and landward shoreline: Price Inlet, South Carolina. Journal of Sedimentary Petrology 54(4) 1303-1313.
- FitzGerald, D.M., and FitzGerald, S.A. (1977) Factors influencing tidal inlet throat geometry. Coastal Sediments, 1977. American Society of Civil Engineers, Charleston, South Carolina, pp563- 581.
- FitzGerald D.M. and Levin D.R. (1981) Hydraulics, Morphology and Sediment Transport Patterns at Pamet River Inlet: Truro, Massachusetts. Journal of Northeastern Geology, 3 (3/4) 216-224.
- FitzGerald, D.M., and Nummedal, D. (1983) Response Characteristics of an ebb-dominated tidal inlet channel. Journal of Sedimentary Petrology. 53(3), 833-845.
- Folk, R.L. (1974) Petrology of Sedimentary Rocks; Hemphills, Austin, Tx, pp170.



- Frazier, D.E. (1967) Recent deltaic deposits of the Mississippi River, their development and chronology. Transactions Gulf Coast Association Geological Society, 17, 287-315.
- Frazier, D.E. (1974) Depositional episodes: their relationship to the Quaternary stratigraphic framework in the northwestern portion of the Gulf basin. Univ. of Texas at Austin, Bureau of Economic Geology Geology Circular 74-1. 28 pp.
- Frey R.W. and P.B. Basan (1985) Coastal Salt Marshes. in R.A. Davis (ed) Coastal Sedimentary Environments. Springer-Verlag, New York, p. 225-289.
- Frey R.W. and J.D. Howard (1969) A Profile of biogenic sedimentary structures in a Holocene barrier island salt marsh complex, Georgia. Transactions Gulf Coast Association Geological Society, 19, 427-444
- Gagliano, S.M.; Meyer-Arendt, K.J.; and Wicker, K.M. (1981) Land Loss in The Mississippi River Deltaic Plain. Transactions Gulf Coast Association Geological Society, 31, 295-300.
- Galloway, W.E. (1975) Process framework for describing the morphologic and stratigraphic evolution of deltaic depositional systems, p. 87-98 in Broussard, M.L. (ed.) Deltas: Models for Exploration. Houston, Tx, Houston Geol. Soc., pp555.
- Gammisch R.A., Hobbs, C.H. III, Byrne, R.J. (1988) Evolution of Tidal Inlet Drainage Basin Systems. Journal of Coastal Research 4 (4) pp543-550.
- Gerdes, R.G. (1982) Stratigraphy and History of development of the Caminada-Moreau beach ridge plain, Southeast Louisiana: M. Sc. Thesis, Dept of Geology, Louisiana State University, pp185.
- Gerdes, R.G. (1985) The Caminada-Moreau beach Ridge Plain, in Penland, S. and Boyd R., (eds), Transgressive Depositional Environments of the Mississippi River Delta Plain: Louisiana Geological Survey Guidebook Series, no. 3. p127 -140
- Gould, H.R. (1970) The Mississippi delta complex: in J.P. Morgan (ed) Deltaic Sedimentation, Modern and Ancient, Society or Economic Paleontologists and Mineralogists No. 15, p 3-30.

- Halsey, S. (1979) Nexus: New Model of Barrier Island Development. in S.P. Leatherman, (ed) Barrier Islands from the Gulf of St. Lawrence to the Gulf of Mexico. p185-210.
- Hamblin, W.K. (1962) X-ray radiography in the study of structures in homogeneous sediments. Journal of Sedimentary Petrologists, 32. 201-210.
- Harper, J.R. (1977) Sediment dispersal trends of the Caminada-Moreau beach ridge system. Transactions - Gulf Coast Association of Geologic Societies. 27.283-289.
- Hart, W.E. (1975) A Numerical Study of Current Velocities and Water Levels in Louisiana's Chandeleur-Breton Sound. Unpubl. PhD diss., Department of Marine Sciences, Louisiana State University, 235 p.
- Hayes M.O. (1979) Barrier Island Morphology as a Function of Tidal and Wave Regime. in S.P. Leatherman (ed), Barrier Islands: from the Gulf of St. Lawrence to the Gulf of Mexico. Academic Press. p 1-27.
- Hayes, M.O. (1975) Morphology of sand accumulations in estuaries. in Cronin, L.E. (ed), Estuarine Research, Vol.2, Geology and Engineering. New York: Academic Press, pp3-22.
- Hayes, M.O. (1964) Summary of geological effects of hurricanes Carla, 1961, and Cindy, 1963 on the South Texas coast. Gulf Coast Association Geological Society Field Trip Guidebook, 1964, Depositional environments south-central Texas coast, p. 128-136.
- Hayes M.O. and T.W. Kana (1976) Terrigenous Clastic Depositional Environments. Tech Report, No. 11-CRD, Coastal Research Division, Dept. of Geology, Univ. of South Carolina, 302 pp.
- Hayes, M.O., S.J. Wilson, D.M. FitzGerald, L.J. Hulmes, and D.K. Hubbard (1975) Coastal Processes and geomorphology; in Environmental Inventory of Kiawah Island. Environment Research Center, Inc., S. Carolina., pp165.
- Historical Plans, Inc. (1985) Accuracy of Historical Maps, unpub. Tech Rept. Department of Urban Plans, Cornell University, Ithaca, N.Y.

- Hjulstrom, F. (1955) Transportation of detritus by moving water, in Trask, (ed.) Recent Marine Sediments, Society of Economic Paleontologists and Mineralogists No. 4, Tulsa, Oklahoma, p. 5-31.
- Howard, P.C. (1983) Quatre Bayou Pass, Louisiana: Analysis of currents, sediments and history. Unpubl. M.S. thesis, Department of Geology, Louisiana State University, p.111.
- Hoyt, J.H. and V.J. Henry (1967) Influence of island migration on barrier island sedimentation. Geological Society of America Bulletin, 82, 2131-2158.
- Hubbard, D.K. and J.N. Barwis (1974) Discussion of tidal inlet sand deposits: Example from the S. Carolina coast. in Hayes, M.O. and Kana, T.W. (eds.), Terrigenous Clastic Depositional Environments, Tech. Rpt No. 11-CRD, Univ. South Carolina, Columbia, p.II-158 - II-171.
- Hubbard, D.K., Barwis, J.H., and Nummedal, D. (1977) Sediment transport in four South Carolina inlets. Coastal Sediments, 1977, 5th symposium of the Waterway, Ports, Coastal and Ocean Division of the American Society of Civil Engineers, Charleston, South Carolina, pp.582-601.
- Hubbard, D.K., G. Oertel, and D. Nummedal (1979) The role of waves and tidal currents in the development of tidal inlet sedimentary structures and sand body geometry: examples from North Carolina, South Carolina, and Georgia. Journal of Sedimentary Petrologists. 49:1073-1092.
- Hubertz, J.M. and R.M. Brooks (1989) WIS Report 18, Gulf of Mexico Hindcast Wave Information, Wave Information Studies of the US Coastline. Department of the Army, Waterways Experiment Station, Vicksburg, MS, pp 420.
- Il, Y.H. (1987) Evolution and sedimentary sequences of the St. Barnard Delta, unpub. M.S. Thesis; Louisiana State University, Baton Rouge, La. pp 193.
- Jarrett, J.T. (1976) Tidal prism-inlet area relationships. General Investigation of Tidal Inlets, Report 3, U.S. Army Corps of Engineers, Coastal Engineering Research Center, Ft. Belvoir, Va. pp.45

- Jeffries, S.A. (1982) Washover processes in a low-profile barrier, Caminada, Louisiana. unpubl. Masters thesis. Department of Geography. Louisiana State University. pp.225
- Kahn, J.H. (1985) Geomorphic Recovery of the Chandeleur Islands, Louisiana, After a Major Hurricane. Journal of Coastal Research, 2(3), 337 - 344.
- Kanes, W.H. (1970) Facies and Development of the Colorado River Delta in Texas. in J.P. Morgan (ed) Deltaic Sedimentation, Modern and Ancient, Society of Economic Paleontologists and Mineralogists Special Publication No. 15, 3-30.
- Kearns, F.E. (1985) Depositional Environments of the Near Surface Sediments of the Sale-Cypremort-Teche Interdistributary Basin, South Central Louisiana. Louisiana State University, Baton Rouge, La. p.34
- King, C.A.M. and M.J. McCulloch (1971) A simulation model of a complex recurved spit. Journal of Geology, 79, 22-37.
- Kolb, C.R. and J.R. Van Lopik (1966) Depositional Environments of the Mississippi River Deltaic Plain, Southeastern Louisiana. Geological Society in M.L. Shirley and J.A. Ragsdale (eds.) Deltas, pp. 17-62. Houston, Texas.
- Kolb, C.R. and J.R. Van Lopik (1958) Geology of the Mississippi River deltaic plain, southern Louisiana: U.S. Corps of Engineers, WES, Reports 3-483 and 3-484, 2 volumes.
- Kosters E.C. (1987) The distribution, quality, and quantity of peats in the Mississippi River Delta. unpubl. dissertation. Department of Marine Sciences, Louisiana State University, pp. 250
- Kumar, N. and J.E. Sanders (1975) Inlet sequence: a vertical succession of sedimentary structures and textures created by the lateral migration of tidal inlets. Sedimentology, 21, 491-532.
- Lanesky, D.E., B.W. Logan, R.G. Brown, and A.C. Hine (1979) A new approach to portable vibracoring under water and on land. Journal of Sedimentary Petrology, (49) 654-657.
- Laury, R.L. (1968) Sedimentology of the Pleasantview sandstone, southern Iowa and Western Illinois. Journal of Sedimentary Petrology, 38, 568-599.

- Leatherman, S.P. (1981) Overwash Processes: Benchmark papers in Geology, v. 58, Stroudsburg, Pa. Hutchinson Ross Publishing Co. 376 p.
- Levin D.R., Nummedal, D., Penland, S., and Howard, P. (1983) Evolution of Tidal Inlets along a Transgressive Deltaic Shoreline. American Association of Petroleum Geologists, National Meeting, Abstracts with Program. Dallas, TX., p.113.
- Lindstedt, D., (1982) Increase in Bay Area and Tidal Prism in Barataria and Caminada Bays. Unpubl. Tech. Rept., Dept of Geology, Louisiana State University, 14 pp.
- Marmer, H.A. (1954) The currents in Barataria Bay: Texas A&M Research Foundation, Project no. 9, pp 30.
- McEwen, M.C. (1969) Sedimentary facies of the modern Trinity Delta, in Holocene Geology of the Galveston Bay Area: Houston Geol. Soc., p53-77.
- Mehta, A.J. (1975) Hydraulics of tidal inlets: Simple analytical models for engineers, Parts I and II of notes on a short course in coastal engineering topics, UFL/COEL-75/019, 020, Coastal and Oceanographic Engineering Laboratory, University of Florida, Gainesville, Fl.
- Milliman J.D. and K.O. Emery (1968) Sea levels during the past 35,000 years. Science, 162, 1121-1123
- Moore, D.G. and P.C. Scruton (1957) Minor internal structures of some recent unconsolidated sediments, American Association Petroleum Geologists Bulletin., v.41, p.2723-2751.
- Morgan, J.P. (1967) Ephemeral estuaries of the deltaic environments, in Lauff, G.H. and Kellogg, W.K. (eds.), Estuaries, American association for the advancement of science, Washington, D.C., p.115.
- Morton, R.A. (1979) Temporal and spatial variations in shoreline changes and their implications; examples from the Texas Gulf Coast, Journal of Sedimentary Petrology 49,1102-1112.
- Morton R.A. and D. Nummedal (1982) Regional geology of the N.W. Gulf coastal plain: in Nummedal D. (ed). Sedimentary Processes and Environments Along the Louisiana - Texas Coast. Geological Society of America Annual Meetin. Field Trip Guidebook, p.3-25.

- Moslow, T.F. (1980) Stratigraphy of mesotidal barrier islands. Phd Dissertation. University of South Carolina, Columbia, S.C. pp. 240.
- Moslow, T.F. and D.R. Levin (1985) Tidal inlet processes and deposits along a low energy coastline: East Barataria Bight, Louisiana. Abstract with Program, Geological Society of America, Orlando, Florida.
- Mossa, J., Penland, S. and Moslow, T.F. (1985) Coastal Structures in Louisiana Barataria Bight. Coastal Geology Technical Report No. 1, Louisiana Geological Survey, Baton Rouge, La. pp.28.
- Nakashima, L.D. (1988) Short-Term Changes in Beach Morphology on the Louisiana Coast. Transactions Gulf Coast Association Geological Society.
- Neese, K.J. (1984) Stratigraphy and geologic evolution of Isles Dernieres, Terrebonne Parish, Louisiana. unpubl. Masters Thesis, Department of Geology, Louisiana State University, pp. 126.
- NOAA (1988) Tide Tables, east coast of North and South America: U.S. Department of Commerce.
- Nummedal D. (1983) Rates and Frequencies of Sea-Level Changes: A Review with an Approach to Predict Future Sea Levels in Louisiana, Gulf Coast Association Geological Society Transaction, 33, 361-366.
- Nummedal, D., Cuomo, R.F., and Penland, S. (1984) Shoreline Evolution Along the Northern Coast of the Gulf of Mexico. Shore and Beach. 52(1): 11-17.
- Nummedal D. and Humphries S.M. (1978) Hydraulics and dynamics if North Inlet, South Carolina, 1975-1976: GITI Report #16, US Army Corps of Engineers, Coastal Engineers Research Center. pp.214
- O'Brien, M.P. (1969) Equilibrium flow area of inlets on sandy coasts. Journal of Waterways and Harbors Division, American Society of Civil Engineers, 95 (1) 43-52.
- O'Brien M.P. and Dean, R.G. (1977) Hydraulics and Sedimentary Stability of Coastal Inlets. Proceedings 13th Coastal Engineering Conference American Society of Civil Engineers. 11: 761-779.

- Oertel, G.F. (1978) Ebb-Tidal Deltas of Georgia Estuaries. in Cronin (ed) Estuarine Research, Volume II, Geology and Engineering. Academic Press. N.Y.. p.267-276
- Oomkens, E. (1970) Depositional Sequences and Sand Distribution in the Postglacial Rhone Delta Complex. in J.P. Morgan (ed) Deltaic Sedimentation, Modern and Ancient Society of Economic Paleontologists and Mineralogists Special Publication No. 15, p 3-30.
- Otvos, E.G. (1969) A subrecent beach ridge complex in southeastern Louisiana. Bulletin Geologic Society of America, 80:2353-2357.
- Penland S. and R. Boyd (1985) Mississippi Delta barrier shoreline development. in S. Penland and R. Boyd (eds) Transgressive depositional environments of the Mississippi River Delta Plain: A Guide to the Barrier Islands, Beaches, and Shoals in Louisiana. Guidebook Series No. 3. Louisiana Geological Survey, Baton Rouge, Louisiana, p.53-116.
- Penland, S., and Boyd, R. (1981) Shoreline changes on the Louisiana Barrier coast: Oceans, p209-219.
- Penland, S., Boyd, R., and Suter, J. R. (1988) Transgressive Depositional Systems of the Mississippi Delta Plain: A Model for Barrier Shoreline and Shelf Sand Development. Journal of Sedimentary Petrology, 58(6), 932 - 949.
- Penland S., K.E. Ramsey, R.A. McBride, T.F. Moslow, and K.A. Westphal (1987b) Relative Sea Level Rise and Subsidence in Louisiana and the Gulf of Mexico. Louisiana Geological Survey, Coastal Geology Technical Report, p125.
- Penland S., J.R. Suter, and R.A. McBride (1987a) Delta Plain development and sea level history in the Terrebone Coastal Region, Louisiana, Coastal Sediments '87, American Society of Civil Engineers, 2:1689-1706.
- Pettijohn, F.J. (1975) Sedimentary Rocks, Harper and Row, New York, pp718.
- Price, W.A. (1947) Equilibrium of form and forces in tidal basins of Texas and Louisiana. Bulletin American Association Petroleum Geologists. 31, 1619-1633.

- Price, W.A. and R.H. Parker (1979) Origins of permanent inlets separating barrier islands and influence of drowned valleys on tidal records along the Gulf coast of Texas. Gulf Coast Association of Geological Societies, Transactions, 29, 371-385.
- Ramsey, K.E. and Moslow, T.F. (1987) A Numerical Analysis of Subsidence and Sea Level Rise in Louisiana. in N.C. Kraus (ed) Coastal Sediments '87, American Society of Civil Engineers, New Orleans, La. pp1673 - 1688.
- Reineck, H. E. and I.B. Singh (1980) Depositional Sedimentary Environments. Springer-Verlag, New York, pp439
- Rhode, H. (1978) The history of the German coastal area, in Die Kuste, Archive for Research and Technology on the North Sea and Baltic Coast, 32, Heide 1. Holse. pl-49.
- Ritchie, W. and S. Penland (1985) Overwash process-response characteristics of the Caminada-Moreau barrier shoreline, Louisiana, in S. Penland and R. Boyd (eds) Transgressive Depositional Environments of the Mississippi River Delta Louisiana Geological Survey, Guidebook Series no.3, p141-176.
- Roberts, H.H., D.W. Cratsley, T. Whelan and J.M. Coleman (1976) Stability of Mississippi delta sediments as evaluated by analysis of structural features in sediment borings. Eighth annual Offshore Technical Conference, p9-28.
- Russell R.J. (1936) Physiography of the lower Mississippi River delta. Reports on the geology of the lower Plaquemines and St. Bernard Parishes, Louisiana Department of Conservation Geological Bulletin 8, p3-193.
- Russell, R.J. (1939) Louisiana Stream Patterns, American Association of Petroleum Geologists Bulletin. 23: 1199-1227
- Salinas L.M., R.D. Delaune, and W.H. Patrick (1986) Changes Occurring Along a Rapidly Submerging Coastal Area: Louisiana, USA. Journal of Coastal Research, 2 (3) 269 - 284.
- Scruton, P.C. (1960) Delta building and the deltaic sequence, in Recent sediments, northwest Gulf of Mexico: Tulsa, Oklahoma, American Association of Petroleum Geologists, p.82-102.



- Shamban A. (1985) Historical Evolution, Morphology and Processes of Barataria Pass, Louisiana. Unpubl. M.S., Department of Geology Louisiana State University. 320 pp.
- Smith L.M., J.B. Dunbar, and L.D. Britsch (1986) Geomorphological investigation of the Atchafalaya Basin, area west, and Terrebone Marsh; Volume 1. Technical Report GL-86-3. US Army Corps of Engineers, CERC, Vicksburg, Ms. pp. 262.
- Smith G.L., and Zurillo, G.A. (1988) Short Term Interactions Between Hydraulics and Morphodynamics of a Small Tidal Inlet, Long Island, New York. Journal of Coastal Research, 4(2), 301 - 314.
- Suter, J.R. and Penland, S. (1987) Evolution of Cat Island Pass, Louisiana. Coastal Sediments '87, American Society of Civil Engineers, 16 p.
- Swanson, R.L. and E.I. Thurlow (1973) Recent subsidence rates along the Texas and Louisiana coast as determined from tide measurements. Journal of Geophysical Research. 78:2665-2671.
- Tanner, W.F., S. Demirpolat, F.W. Stapor, and L. Alvarez (1989) The "Gulf of Mexico" Late Holocene Sea Level Curve. Transactions-Gulf Coast Association of Geologists Society. 39, 553-562.
- Tarver, J.W. (1972) Occurrence, distribution and density of Rangia cuneata in Lakes Ponchartrain and Maurepas, Louisiana. Louisiana Wildlife and Fisheries Commission, Oysters, Water Bottoms and Seafood Division. Technical Bulletin no. 1. pp.8.
- Tarver, J.W. and R.J. Dugas (1973) A study of the clam, Rangia cuneata, in Lake Pontchartrain and Lake Maurepas, Louisiana. Louisiana Wild Life and Fisheries Commission, Oyster, Water Bottoms, and Seafoods Division, Technical Bulletin no. 5, pp.97.
- Tubb, M. (1972) "Sea Carpet" protects against tides, currents, and wave-wash. Ocean Industry, vol.7, pp. 126.
- Tye, R.S. (1986) Non-marine Atchafalaya deltas; processes and products of interdistributary basin alluviation. unpubl. Phd dissertation. Department of Marine Sciences. Louisiana State University, Baton Rouge, Louisiana. pp. 250.

- Tye, R.S. (1985) Geomorphic evolution and stratigraphic framework of Price and Capers Inlets, South Carolina. Sedimentology 31:655-674.
- U.S. Army Corps of Engineers (1972) Grand Isle and vicinity, Louisiana review report: beach erosion and hurricane protection: New Orleans District, New Orleans, La.
- Vail, P.R., R.M. Mitchum and S. Thompson III (1977) Seismic Stratigraphy and global changes of sea level, Part 4: Seismic Stratigraphic Interpretation Procedure, in C.P. Payton (ed) Seismic Stratigraphy-applications to hydrocarbon exploration, Society of Economic Paleontologists and Mineralogists Memoir 26. American Association of Petroleum Geologists. p.83-97.
- van Heerden, I. L., J.T. Wells, and H.H. Roberts (1981) Evolution and morphology of sedimentary environments, Atchafalaya delta. Louisiana. Transactions - Gulf Coast Association Geologic Society, 31: 399-408.
- Van Wagoner, J.C., R.M. Mitchum, Jr., H.W. Possamentier and P.R. Vail (1987) Part 2: Key definitions of sequence stratigraphy. in A.W. Bally (ed), American Association of Petroleum Geologists Studies in Geology #27. American Association of Petroleum Geologists p.11-53.
- Visher, G.S. (1969) Grain size distribution and depositional processes. Journal of Sedimentary Petrology 39. 1074-1106
- Warne, J.E. (1971) Paleoecological aspects of a modern coastal lagoon. Univ. California Publications in Geologic Sciences., 87, 1-131.
- Wax, C.L. (1978) Barataria Basin: Synoptic weather types and environmental responses. Coastal and Wetland Resources, Louisiana State University. CWR-LSU, pp 60.
- Wayne, C.J. (1976) The effects of sea and marsh grass on wave energy. Coastal Research Notes, 4 (7), pp.6-8.
- Welder, F.A. (1959) Processes of deltaic sedimentation in the Lower Mississippi River. LSU, Coastal Studies Institute., Baton Rouge, Tech. Rpt. no. 12, pp 174.
- Wright, L.D. (1985) River Deltas. in R.A. Davis (ed) Coastal Sedimentary Environments. Springer-Verlag, New York, p. 1-76.

Wright L.D. and J.M. Coleman (1972) River delta morphology:  
wave climate and the role of the subaqueous profile.  
Science, 176, 282-284.

Wright, L.D., J.M. Coleman, and M.W. Erickson (1974)  
Analysis of major river systems and their deltas:  
morphologic and process comparisons. Louisiana State  
University, Coastal Studies Institute Tech Rpt. 156, pp  
114.

## APPENDIX I

The original source for the map/information is listed first followed by the source in which it had been published more recently (where appropriate).

Jeffreys : 1759 : Mississippi River Delta,  
Historic Urban Plans, Ithaca, New York, 1971.

Barnard: 1841: Grande Terre Island, Louisiana, Corps of  
Engineers, New Orleans, Louisiana

Hughs: 1842: Gulf Bathymetry, in: Howard, 1981

Gerdes: 1853: Planimetry and Bay Bathymetry of Quatre  
Bayou Area in: Howard, 1981

USCGS: 1883/1886: Quatre Bayou Pass/ Cheniere  
Ronquille in: Howard, 1981

Leach, Turtle & Thomas: 1887: Mississippi River Delta

USCGS : 1934 : Quatre Bayou Pass

USCGS : 1934 : Gulf Bathymetry

USCGS : 1945 : Quatre Bayou Pass, in: Howard, 1981

USCGS : 1956 : in: Penland et al., 1981

USCGS : 1961 : Quatre Bayou Pass, in: Howard, 1981

USCGS : 1973 : Barataria Pass to Bay Ronquille

USCGS : 1978 : Eastern Barataria Bight, in: Penland et  
al., 1981

\* USCGS - United States Coast and Geodetic Survey

Aerial Photographs:

Remote Sensing Group LSU : 1981 : Grande Terre region

## APPENDIX II

### SEDIMENTARY STATISTICS ASSOCIATED WITH SANDY ENVIRONMENTS OF DEPOSITION IN THE BARATARIA REGION

| CORE               | DEPTH | MN phi | SORT | SKEW   | KURT  |
|--------------------|-------|--------|------|--------|-------|
| <b>BARRIER</b>     |       |        |      |        |       |
| CRC-1              | 10 cm | 2.83   | 0.96 | 0.421  | 0.943 |
| CRC-1              | 35    | 2.85   | 0.96 | 0.289  | 0.920 |
| CRC-1              | 70    | 3.06   | 1.34 | -0.095 | 1.085 |
| PAW-1              | 10    | 2.83   | 0.95 | 0.17   | 1.130 |
| PAW-1              | 50    | 2.76   | 1.12 | 0.001  | 1.46  |
| PAE-1              | 156   | 3.06   | 1.16 | 0.16   | .922  |
| PAE-1              | 194   | 2.96   | 0.97 | -0.03  | .779  |
| QBP-C-1            | 83    | 3.32   | 1.30 | 0.287  | 1.161 |
| <b>BACKBARRIER</b> |       |        |      |        |       |
| CRC-1              | 108   | 3.02   | 1.14 | 0.15   | 0.881 |
| CRC-1              | 133   | 3.06   | 1.13 | -0.03  | 0.833 |
| CRC-1              | 150   | 3.04   | 1.11 | 0.05   | 0.776 |
| CRC-1              | 175   | 3.03   | 1.12 | 0.143  | 0.738 |
| CRC-1              | 181   | 3.25   | 1.10 | -0.042 | 1.230 |
| CRC-4              | 630   | 3.10   | 1.40 | 0.27   | 1.009 |
| PAE-2/3            | 85    | 3.25   | 1.22 | 0.171  | 1.182 |
| PAE-2/3            | 125   | 3.10   | 1.07 | 0.252  | 1.047 |
| PAE-2/3            | 147   | 3.32   | 1.28 | 0.292  | 1.230 |
| PAW-2              | 85    | 2.65   | 1.14 | -0.138 | 1.332 |
| PAW-3              | 110   | 3.11   | 1.11 | -0.086 | 0.847 |
| QBP-C-3            | 330   | 3.12   | 1.05 | 0.033  | 1.127 |
| QBP-C-3            | 345   | 3.22   | 1.19 | 0.120  | 1.651 |
| <b>BAY</b>         |       |        |      |        |       |
| CRC-2              | 110   | 3.4    | 1.14 | 0.274  | .888  |
| CRC-2              | 100   | 3.04   | 1.3  | -0.004 | 1.072 |
| PAS-2              | 138   | 3.17   | 1.12 | -0.091 | 1.138 |

**Appendix II**

| <b>CORE</b>         | <b>DEPTH</b> | <b>MN phi</b> | <b>SORT</b> | <b>SKEW</b> | <b>KURT</b> |
|---------------------|--------------|---------------|-------------|-------------|-------------|
| <b>BAYFILL</b>      |              |               |             |             |             |
| PAT                 | 800          | 3.53          | 1.16        | 0.208       | 0.999       |
| PAT                 | 831          | 3.39          | 1.26        | 0.163       | 1.639       |
| <b>CHANNEL FILL</b> |              |               |             |             |             |
| CRB-6               | 275          | 3.44          | 1.33        | 0.328       | 1.459       |
| PAE-6               | 128          | 3.33          | 2.00        | -0.383      | 3.346       |
| PAE-6               | 251          | 3.44          | 1.24        | 0.291       | 0.794       |
| PAT-3               | 580          | 3.57          | 1.14        | 0.177       | 0.666       |
| PAT-3               | 580          | 3.7           | 1.84        | -0.294      | 1.639       |
| PAT-3               | 600          | 3.52          | 1.28        | 0.092       | 1.215       |
| QBP-C-3             | 238          | 3.42          | 1.3         | 0.272       | 1.548       |
| <b>CHANNEL</b>      |              |               |             |             |             |
| CR3                 | 213          | 2.97          | 0.99        | 0.227       | 0.73        |
| CR6                 | 270          | 2.99          | 1.00        | 0.45        | 0.745       |
| CR7                 | 255          | 3.02          | 0.98        | 0.04        | 0.656       |
| CR8                 | 60           | 3.30          | 1.18        | 0.124       | 1.171       |
| CR8                 | 80           | 3.27          | 1.19        | 0.065       | 1.204       |
| CRB-2               | 70           | 3.04          | 1.28        | 0.14        | 0.966       |
| CRB-6               | 88           | 3.01          | 1.14        | 0.252       | 0.82        |
| CRB-6               | 135          | 3.25          | 1.19        | 0.007       | 1.323       |
| CRB-6               | 150          | 3.34          | 1.17        | 0.083       | 1.44        |
| CRC-3               | 665          | 3.19          | 1.26        | -0.039      | 1.681       |
| CRD-1               | 425          | 3.03          | 0.97        | -0.204      | 0.779       |
| CRD-1               | 573          | 3.13          | 1.14        | -0.168      | 1.175       |
| CRD-1               | 580          | 3.07          | 1.06        | -0.08       | 1.02        |
| CRD-1               | 583          | 3.25          | 1.14        | -0.006      | 1.391       |
| CRD-1               | 600          | 3.24          | 1.10        | -0.07       | 1.405       |
| CRD-2               | 182          | 3.33          | 1.32        | 0.25        | 1.091       |
| PAE-4               | 390          | 3.94          | 1.30        | -0.354      | 0.995       |
| PAE-4               | 400          | 3.70          | 1.18        | 0.004       | 0.802       |

**Appendix II**

| <b>CORE</b>                       | <b>DEPTH</b> | <b>MN phi</b> | <b>SORT</b> | <b>SKEW</b> | <b>KURT</b> |
|-----------------------------------|--------------|---------------|-------------|-------------|-------------|
| <b>CHANNEL</b>                    |              |               |             |             |             |
| PAE-5                             | 335          | 3.08          | 1.17        | 0.236       | 1.028       |
| PAE-5                             | 360          | 3.27          | 1.26        | 0.292       | 1.56        |
| PAN-5                             | 200          | 3.13          | 1.18        | 0.074       | 0.956       |
| PAS-1                             | 224          | 3.27          | 1.20        | -0.113      | 1.503       |
| PAS-1                             | 235          | 3.23          | 1.70        | -0.158      | 1.722       |
| PAS-1                             | 252          | 3.12          | 1.30        | -0.176      | 1.124       |
| PAS-1                             | 280          | 3.20          | 1.18        | -0.074      | 1.325       |
| PAS-1                             | 285          | 3.47          | 1.28        | 0.045       | 1.04        |
| PAS-2                             | 258          | 2.98          | 1.05        | 0.199       | 0.82        |
| PAS-2                             | 330          | 3.13          | 1.20        | -0.073      | 1.321       |
| QBP-B-1                           | 241          | 2.88          | 0.89        | 0.477       | 1.058       |
| QBP-B-2                           | 255          | 3.04          | 1.36        | 0.107       | 1.083       |
| QBP-B-5                           | 500          | 2.95          | 1.41        | 0.138       | 1.639       |
| QBP-B-5                           | 520          | 3.58          | 2.00        | -0.166      | 1.929       |
| QBP-B-5                           | 540          | 3.13          | 1.18        | 0.326       | 1.043       |
| <b>CHANNEL/ PROXIMAL OVERBANK</b> |              |               |             |             |             |
| CRD-1                             | 498          | 3.08          | 1.08        | -0.003      | 0.827       |
| CRD-1                             | 511          | 3.11          | 1.11        | -0.208      | 0.826       |
| <b>CHANNEL MARGIN</b>             |              |               |             |             |             |
| CR6                               | 90           | 3.09          | 1.20        | -0.043      | 0.977       |
| CR8                               | 121          | 3.08          | 1.16        | -0.089      | 0.845       |
| CR8                               | 136          | 3.2           | 1.17        | -0.077      | 1.315       |
| CRB-6                             | 70           | 3.34          | 1.26        | 0.233       | 1.192       |
| CRC-5                             | 130          | 3.11          | 1.09        | -0.111      | 0.879       |
| CRC-5                             | 140          | 3.21          | 1.21        | -0.077      | 1.721       |
| PAN-5                             | 25           | 3.02          | 1.14        | 0.019       | 0.813       |
| PAN-5                             | 80           | 3.13          | 1.14        | -0.133      | 0.888       |
| QBP-B-2                           | 12           | 3.26          | 1.26        | 0.208       | 1.261       |

**Appendix II**

| <b>CORE</b>                 | <b>DEPTH</b> | <b>MN phi</b> | <b>SORT</b> | <b>SKEW</b> | <b>KURT</b> |
|-----------------------------|--------------|---------------|-------------|-------------|-------------|
| <b>DELTA FRONT</b>          |              |               |             |             |             |
| CR3                         | 275          | 3.04          | 1.04        | -0.013      | 0.638       |
| CR3                         | 281          | 3.00          | 0.99        | 0.046       | 0.73        |
| CRD-1                       | 603          | 3.26          | 1.10        | 0.02        | 1.294       |
| CRD-1                       | 620          | 2.98          | 0.99        | 0.118       | 0.738       |
| PAE-5                       | 445          | 3.33          | 1.26        | 0.286       | 1.311       |
| PAW-3                       | 500          | 3.58          | 1.38        | 0.118       | 0.916       |
| QBP-B-3                     | 230          | 3.03          | 0.95        | 0.152       | 0.671       |
| QBP-B-5                     | 586          | 3.58          | 1.95        | -0.165      | 1.639       |
| <b>FLOOD TIDAL DELTA</b>    |              |               |             |             |             |
| CRC-4                       | 702          | 3.02          | 1.12        | 0.09        | 0.931       |
| CRC-4                       | 726          | 2.99          | 0.97        | -0.031      | 0.779       |
| CRD-1                       | 635          | 3.07          | 1.00        | 0.001       | 0.683       |
| CRD-1                       | 635          | 3.15          | 1.3         | 0.01        | 1.393       |
| PAE-4                       | 9            | 3.29          | 1.1         | -0.037      | 1.093       |
| PAN-4                       | 77           | 3.00          | 0.98        | 0.031       | 0.656       |
| PAN-4                       | 10           | 2.90          | 1.12        | 0.124       | 1.033       |
| <b>OVERBANK DISTAL</b>      |              |               |             |             |             |
| CRC-3                       | 86           | 3.27          | 1.33        | 0.124       | 1.236       |
| CRC-3                       | 175          | 3.27          | 1.32        | 0.095       | 1.464       |
| CRC-3                       | 186          | 3.37          | 1.20        | 0.092       | 1.486       |
| <b>MARSH (sand laminae)</b> |              |               |             |             |             |
| CRC-2                       | 20           | 3.27          | 1.34        | 0.135       | 1.19        |
| CRC-2                       | 31           | 3.27          | 1.24        | 0.075       | 1.246       |
| CRC-2                       | 81           | 3.17          | 1.20        | -0.147      | 1.302       |
| CRC-3                       | 48           | 3.10          | 1.87        | -0.334      | 2.115       |
| CRC-4                       | 37           | 3.45          | 1.30        | 0.108       | 1.072       |



## Appendix II

| CORE              | DEPTH | MN phi | SORT | SKEW   | KURT  |
|-------------------|-------|--------|------|--------|-------|
| OVERBANK PROXIMAL |       |        |      |        |       |
| CR1-B             | 188   | 3.3    | 1.35 | 0.257  | 1.087 |
| CR4               | 190   | 3.4    | 1.24 | 0.30   | 1.27  |
| PAT               | 200   | 3.32   | 1.14 | 0.359  | 1.332 |
| PAT               | 222   | 3.17   | 1.12 | -0.051 | 0.931 |
| PAT               | 236   | 3.27   | 1.22 | 0.233  | 0.878 |
| PAT               | 242   | 3.39   | 1.24 | 0.201  | 0.907 |
| CR1               | 255   | 3.04   | 1.01 | -0.157 | 0.844 |
| CRB-2             | 275   | 3.87   | 1.66 | -0.575 | 1.409 |
| CRC-5             | 270   | 3.22   | 1.28 | 0.163  | 1.503 |
| CRD-5             | 158   | 3.35   | 1.28 | 0.289  | 1.554 |
| CRD-5             | 187   | 3.18   | 1.67 | -0.151 | 1.417 |
| PAN-4             | 480   | 3.6    | 1.32 | 0.194  | 1.025 |
| PAS-2             | 535   | 3.24   | 1.28 | 0.06   | 1.146 |
| PAT-3             | 186   | 3.08   | 0.97 | 0.15   | 0.779 |
| PAW-1             | 258   | 3.11   | 1.02 | -0.274 | 0.782 |
| PAW-1             | 380   | 3.03   | 1.12 | 0.17   | 0.854 |
| PAW-2             | 245   | 3.18   | 1.21 | -0.128 | 1.205 |
| PAW-2             | 287   | 3.2    | 1.10 | -0.125 | 1.113 |
| QBP-B-1           | 570   | 3.42   | 1.41 | 00.141 | 1.639 |
| QBP-B-4           | 280   | 3.08   | 1.20 | 0.252  | 1.189 |
| QBP-B-4           | 255   | 2.98   | 1.02 | 0.238  | 0.861 |
| QBP-B-7           | 533   | 2.71   | 0.97 | -0.186 | 1,112 |
| QBP-C-4           | 240   | 3.46   | 1.26 | 0.267  | 0.937 |
| QBP-C-4           | 285   | 3.15   | 1.00 | -0.05  | 0.976 |
| QBP-C-4           | 405   | 3.07   | 1.19 | 0.322  | 1.051 |
| CRD-5             | 57    | 2.95   | 1.05 | 0.369  | 0.82  |

**Appendix II**

| <b>CORE</b>                             | <b>DEPTH</b> | <b>MN phi</b> | <b>SORT</b> | <b>SKEW</b> | <b>KURT</b> |
|-----------------------------------------|--------------|---------------|-------------|-------------|-------------|
| <b>PASS PLATFORM</b>                    |              |               |             |             |             |
| CRB-4                                   | 10           | 2.92          | 1.10        | 0.170       | 0.827       |
| CRB-4                                   | 35           | 2.92          | 1.14        | 0.125       | 1.066       |
| CRD-2                                   | 8            | 3.11          | 1.1         | -0.07       | 0.82        |
| CRD-2                                   | 27           | 3.18          | 1.1         | -0.194      | 1.171       |
| CRD-2                                   | 50           | 3.07          | 1.1         | 0.04        | 0.723       |
| CRD-2                                   | 85           | 3.305         | 0.99        | -0.126      | 0.73        |
| CRD-2                                   | 75           | 3.03          | 1.00        | -0.13       | 0.745       |
| CRD-2                                   | 75           | 3.05          | 1.00        | -0.172      | 0.753       |
| CRD-2                                   | 80           | 3.37          | 0.99        | 0.34        | 0.902       |
| CRD-2                                   | 82           | 3.35          | 1.13        | 0.147       | 1.311       |
| CRD-2                                   | 377          | 3.11          | 1.07        | -0.091      | 1.047       |
| CRD-4                                   | 8            | 3.05          | 1.12        | -0.068      | 0.854       |
| CRD-4                                   | 28           | 3.08          | 1.17        | 0.05        | 0.87        |
| CRD-4                                   | 36           | 3.43          | 1.26        | 0.131       | 1.093       |
| CRD-5                                   | 8            | 3.01          | 1.00        | 0.062       | 0.745       |
| CRD-5                                   | 36           | 3.11          | 1.14        | -0.051      | 0.976       |
| CRD-5                                   | 45           | 2.96          | 1.50        | -0.190      | 1.412       |
| PAS-6                                   | 80           | 3.15          | 1.35        | 0.258       | 1.008       |
| PAS-6                                   | 71           | 3.06          | 1.10        | 0.098       | 0.833       |
| <b>SPIT</b>                             |              |               |             |             |             |
| PAS-1                                   | 85           | 3.03          | 1.52        | -0.203      | 1.496       |
| PAS-1                                   | 103          | 3.19          | 1.24        | -0.067      | 1.44        |
| <b>TRANSGRESSIVE SANDS (RAVINEMENT)</b> |              |               |             |             |             |
| CRC-2                                   | 158          | 3.18          | 1.12        | -0.203      | 1.314       |
| PAE-6                                   | 785          | 3.48          | 1.34        | 0.21        | 0.868       |

**((STATISTICS USING EQUATIONS FROM FOLK (1974))**

## VITA

Douglas Ross Levin has held several positions with private industry since receiving his Masters degree in Geology from Boston University. As a graduate student at B.U. he concentrated on the dynamics of sedimentation in coastal settings, especially tidal inlets. In 1980 he became an Assistant Scientist for EG&G Oceanographic in Waltham, Massachusetts. In that capacity he assisted in the deployment of oceanographic instrumentation, data analysis, and report writing. In 1982 he enrolled in the Department of Marine Sciences, Louisiana State University as a doctoral student. In 1985, after finishing the data collection phase of his dissertation research he took a job with Ocean Surveys, Inc., Old Saybrook, Connecticut. There he was responsible for all phases of nearshore and coastal geologic/geotechnical investigations conducted for environmental and engineering purposes. As part of that position he traveled to Africa to transfer computer aided bathymetric technologies to the Zaire Hydrographic Survey Agency. He also designed and implemented a search mission to map Cortes's treasures thought to lie in the vicinity of Vera Cruz, Mexico. Early in 1989 he returned to Louisiana State University to finish writing his dissertation. During this time he was employed at the Coastal Engineering Research Center of the Army Corps of Engineers in Vicksburg, Mississippi investigating the occurrence of sand waves in navigation channels nationwide. In fall of 1990 he

joined the faculty in the Department of Science at Bryant College, Smithfield, Rhode Island.

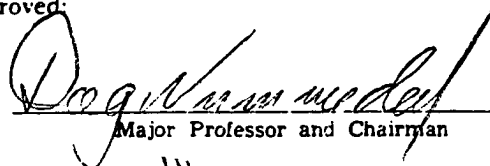
DOCTORAL EXAMINATION AND DISSERTATION REPORT

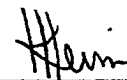
Candidate: Douglas R. Levin

Major Field: Marine Sciences

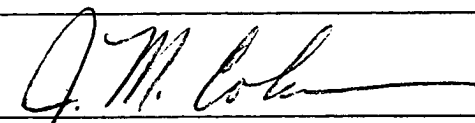
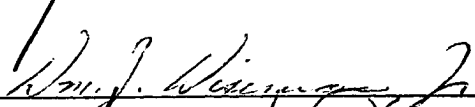
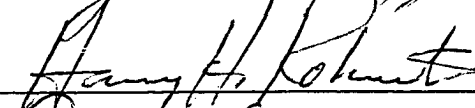
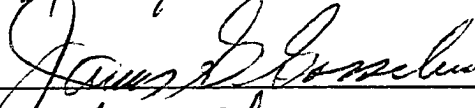
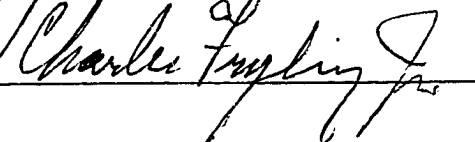
Title of Dissertation: Transgressions and Regressions in the Barataria Bight  
Region of Coastal Louisiana

Approved:

  
Major Professor and Chairman

  
Dean of the Graduate School

EXAMINING COMMITTEE:

Date of Examination:

August 24, 1990